Amami Oshima Frog *(Odorrana splendida)*

Size: Body length, 9.2 - 12.3 cm **Weight:** Up to 300 g **Habitat:** Old-growth, broad-leaved evergreen forests of Amami Oshima Island **Surviving number:** Unknown

Photographed by Shawn Miller

WILDLIFE AS CANON SEES IT

Come closer…closer. The short, single-note mating call of the male Amami Oshima frog is intended to draw females to a spot he's discovered for them to deposit eggs: an underground water hole on the side of a rocky stream. But such prized locations are getting harder to find as the endemic amphibian's already limited range becomes ever more fragmented. Habitat loss is bad enough, but an introduced mongoose species is also ravaging populations. We may be coming closer to the day when this frog is but a memory.

As Canon sees it, images have the power to raise awareness of the threats facing endangered species and the natural environment, helping us make the world a better place.

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NATIONAL GEOGRAPHIC

SPECIAL ISSUE

WALKING AMONG MIGRANTS

BABIES BORN AS REFUGEES

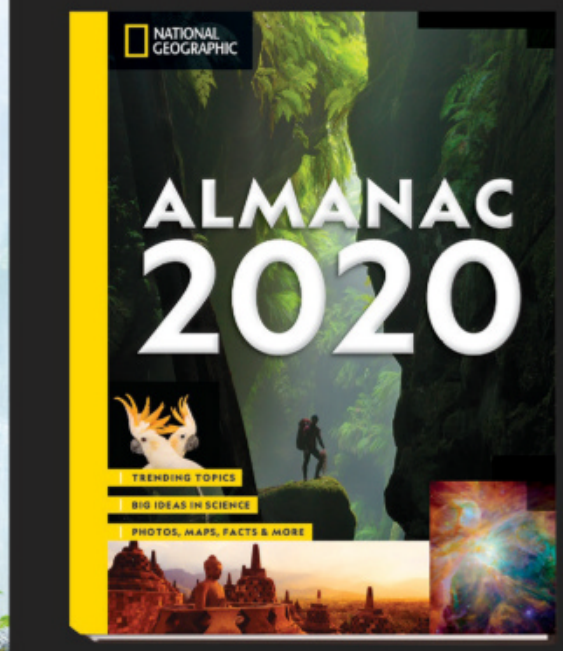
LEAVING AFRICA FOR THE GAMBLE OF A LIFETIME

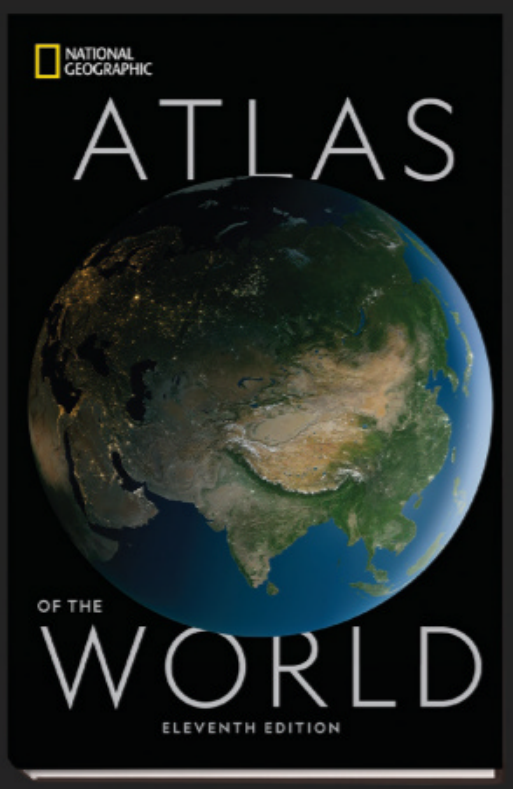
U.S.-MEXICO BORDER PORTRAITS

WORLD ON THE MOVE

Seas rise, crops wither, wars erupt. Humankind again seeks shelter in another place.

EXPLORE THE WORLD AND ALL THAT'S IN IT





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NATIONAL GEOGRAPHIC

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K M ASAD

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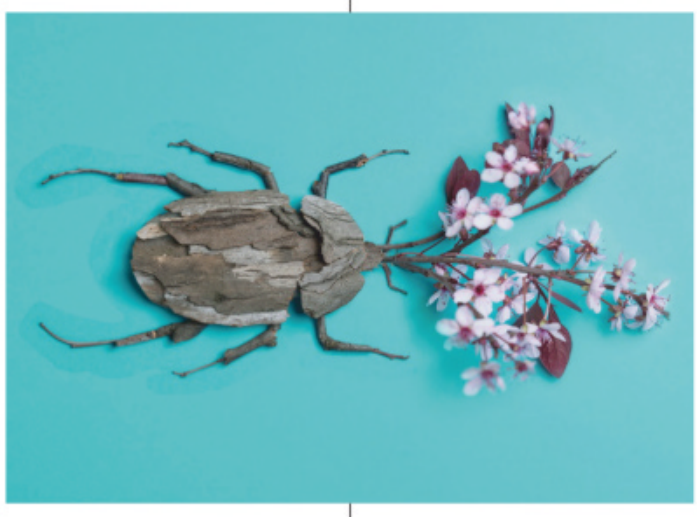

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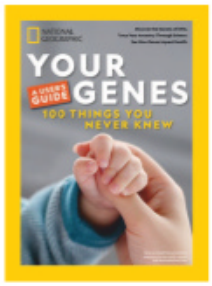
NAT GEO TV

Take *Uncharted* Food Treks With Chef Gordon Ramsay

In the new series *Gordon Ramsay: Uncharted,* one of television's best known chefs leads viewers on anthropology-through-cuisine expeditions. Each episode follows Ramsay as he meets with indigenous peoples and local food legends to explore cultures, customs, and flavors from around the world, including Peru (above), New Zealand, and Morocco. See Ramsay serve up a taste of adventure when the series debuts at 10/9c on July 21 on National Geographic.



ON NEWSSTANDS

A Guide to Your Genetic Mysteries

Explore advances in DNA analysis, and learn about your genetic legacy. National Geographic's *Your Genes, A User's Guide: 100 Things You Never Knew About Human Genetics* is available now on newsstands.

BOOKS

Chicken and Your Health, in *Plucked*

Now in paperback, this provocative narrative by investigative journalist Maryn McKenna reveals the surprising ways that antibiotic use has changed America's favorite meat. *Plucked* is available where books are sold and at *shopng.com/books*.

NAT GEO WILD

Enter the *Kingdom of the White Wolf*

Photographer Ronan Donovan travels to rugged Ellesmere Island in the high Arctic to track and observe a legendary animal. The three-hour special, *Kingdom of the White Wolf,* airs on August 25 starting at 9/8c on Nat Geo WILD.

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PHOTO: ERNESTO BENAVIDES, NATIONAL GEOGRAPHIC

COVERING MIGRATION

Humanity in motion

BY **SUSAN GOLDBERG** PHOTOGRAPH BY **JOHN STANMEYER**

A Kurdish family waits in a car after fleeing Syria for Turkey, to escape an Islamic State advance. Some 150,000 Syrians—most of them Kurds—crossed into Turkey in one 72-hour period in September 2014.

FIVE YEARS AGO I spent a few days with National Geographic Fellow Paul Salopek, a writer who is walking around the world, retracing the journey begun when modern humans first left Africa. Salopek's walking 21,000 miles; I joined him for five miles I'll never forget.

In Şanlıurfa, a dusty town in southern Turkey that is reputed to be the birthplace of Abraham, we found ourselves in the middle of a humanitarian crisis. Everywhere we looked, we saw Syrian refugees—in throngs on the streets, in small apartments crammed with multiple families. We saw people unable to find work of any kind, no matter their skills or education. We talked with people scared and scarred by their country's brutal civil war; we heard stories of suffering, rape, torture, and other horrific crimes.

At the time, the United Nations reported that 51 million people worldwide had been forcibly displaced, for reasons ranging from war to economic hardship. That report declared the 2013 refugee count the highest since World War II. Unfortunately, the record's been broken every year since. The latest UN report says 68.5 million people had been forcibly displaced by the end of 2017.

Humankind has always been on the move, fleeing a peril or searching for something better. In this month's issue, we focus on those migrations, past and present. Writer Andrew Curry takes us inside a new science—paleogenetics—and explains what it's revealing about the migrations that have shaped the populations of modern Europe.

Salopek journeys by choice, unlike many of the migrants he meets. His cover story describes the desperation of those trying to escape war, starvation, disaster: "How strong is the push to leave? To abandon what you love? To walk into the unknown with all your possessions stuffed into a pocket? It is more powerful than fear of death."

The World Bank says that by 2050, the effects of climate change will spur some 143 million people to migrate. As one global threat compounds another, we will continue to provide thorough and meaningful coverage of these human journeys.

Thank you for reading *National Geographic*.

Paul Salopek began his Out of Eden Walk in 2013. Supported by the National Geographic Society and the Knight Foundation, he's covering the major stories of our time by giving voice to the people who inhabit them. Follow him online at *outofedenwalk.org*.

PROOF

NATIONAL GEOGRAPHIC

PHOTOGRAPHS BY **RAKU INOUE**

LOOKING AT THE EARTH FROM EVERY POSSIBLE ANGLE

A butterfly constructed of rose petals offers a fresh way to see nature—and waste. When a local florist has leftover flowers, artist Raku Inoue finds a way to give them new life.

BUILDING BUGS WITH BLOOMS

An artist uses natural materials to make lively and lifelike insect portraits.

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A stag beetle is a cultural symbol in Inoue's native Japan. To make one in tribute, Inoue collected every shade of green he could find in his Montreal backyard.

After a flower shop in Ecuador sent Inoue a shipment of baby's breath and carnation stems, he fashioned them into a horn beetle.

During a trip to Arizona and Nevada, Inoue gathered materials to honor the Southwest's flora and fauna by creating a desert ant (top) and a scorpion (bottom).

The goliath beetle, which can grow to a length of more than four inches, is one of Earth's biggest insects. Inoue usually makes his sculptures without adhesives, but for complex projects, he'll use glue and tape.

THE BACKSTORY

NATURE'S COLORS AND SHAPES SPRING TO LIFE IN STUNNING INSECT SCULPTURES.

TROPICAL PLANTS aren't abundant in the northern latitudes of Montreal, Canada. Nor are the planet's most diverse animals, insects. Even so, Montreal-based artist and photographer Raku Inoue finds a way to showcase both with his colorful portraits of insects and other animals made from flowers, leaves, twigs, seeds, and stems.

"Insects have always been symbolic for me," says Inoue, who grew up in Japan. Each summer his grandmother would leave the door open to cool their house in the countryside near Hiroshima and welcome in dragonflies, an insect that she believed represented the presence of her late husband.

Now Inoue makes dragonflies, beetles, ants, and whatever else inspires him, using materials from his own backyard. He takes leftover rose petals and baby's breath from nearby florists, and occasionally people will send him plants from other parts of the world to challenge his creativity. During a recent trip to the American Southwest, he wanted badly to see a scorpion. When none appeared, he did the next best thing: He collected twigs and seeds, and made one. **–DANIEL STONE**

Inoue brought an orchid mantis to life with orchid petals.

THE DISCOVERIES OF TODAY THAT WILL DEFINE THE WORLD OF TOMORROW

NATIONAL GEOGRAPHIC | VOL. 236 NO. 2

We Are All Migrants

HUMANS ARE A MIGRATORY SPECIES, YET SOME WOULD DIVIDE US INTO TWO KINDS: THE MIGRANT AND THE NATIVE.

BY **MOHSIN HAMID**

ALL OF US ARE DESCENDED from migrants. Our species, *Homo sapiens,* did not evolve in Lahore, where I am writing these words. Nor did we evolve in Shanghai or Topeka or Buenos Aires or Cairo or Oslo, where you, perhaps, are reading them.

Even if you live today in the Rift Valley, in Africa, mother continent to us all, on the site of the earliest discovered remains of our species, your ancestors too moved—they left, changed, and intermingled before returning to the place you live now, just as I left Lahore, lived for decades in North America and Europe, and returned to reside in the house where my grandparents and parents once did, the house where I spent much of my childhood, seemingly indigenous but utterly altered and remade by my travels.

None of us is a native of the place we call home. And none of us is a native to this moment in time. We are not native to the instant, already gone, when this sentence began to be written, nor to the instant,

WE MOVE WHEN IT IS INTOLERABLE TO STAY WHERE WE ARE. WE MOVE BECAUSE OF ENVIRONMENTAL STRESSES AND PHYSICAL DANGERS AND THE SMALL-MINDEDNESS OF OUR NEIGHBORS—AND TO BE WHO WE WISH TO BE, TO SEEK WHAT WE WISH TO SEEK.

also gone, when it began to be read, nor even to this moment, now, which we enter for the first time and which slips away, has slipped away, is irrevocably lost, except from memory.

To be human is to migrate forward through time, the seconds like islands, where we arrive, castaways, and from which we are swept off by the tide, arriving again and again, in a new instant, on a new island, one we have, as always, never experienced before. Over the course of a life these migrations through the seconds accrue, transform into hours, months, decades. We become refugees from our childhoods, the schools, the friends, the toys, the parents that made up our worlds all gone, replaced by new buildings, by phone calls, photo albums, and reminiscences. We step onto our streets looking up at the towering figures of adults, we step out again a little later and attract the gazes of others with our youth, and later still with our own children or those of our friends—and then once more, seemingly invisible, no longer of much interest, bowed by gravity.

We all experience the constant drama of the new and the constant sorrow of the loss of what we've left behind. It is a universal sorrow and one so potent that we seek to deny it, rarely acknowledging it in ourselves, let alone in others. We're encouraged by society to focus only on the new, on acquisition, rather than on the loss that is the other thread uniting and binding our species.

We move through time, through the temporal world, because we are compelled to. We move through space, through the physical world, seemingly because we choose to, but in those choices there are compulsions as well. We move when it is intolerable to stay where we are: when we cannot linger a moment longer, alone in our stifling bedroom, and must go outside and play; when we cannot linger a moment longer, hungry on our parched farm, and must go elsewhere for food. We move because of environmental stresses and physical dangers and the small-mindedness of our neighbors—and to be who we wish to be, to seek what we wish to seek.

Ours is a migratory species. Humans have always moved. Our ancestors did, and not linearly, like an army advancing out of Africa in a series of bold thrusts, but circuitously, sometimes in one direction,

ILLUSTRATION BY ANA JUAN

then in another, borne along by currents both without and within. Our contemporaries are moving—above all from the countryside to the cities of Asia and Africa. And our descendants will move too. They will move as the climate changes, as sea levels rise, as wars are fought, as one mode of economic activity dies out and gives way to another.

The power of our technology, its impact on our planet, is growing. Consequently the pace of change is accelerating, giving rise to new stresses, and our nimble species will use movement as part of its response to these stresses, as our great-grandmothers and great-grandfathers did, as we are designed to do.

And yet we are told that such movement is unprecedented, that it represents a crisis, a flood, a disaster. We are told that there are two kinds of humans, natives and migrants, and that these must struggle for supremacy.

We are told not only that movement through geographies can be stopped but that movement through time can be too, that we can return to the past, to a better past, when our country, our race, our religion was truly great. All we must accept is division. The division of humanity into natives and migrants. A vision of a world of walls and barriers, and of the guards and weapons and surveillance required to enforce those barriers. A world where privacy dies, and dignity and equality alongside it, and where humans must pretend to be static, unmoving, moored to the land on which they currently stand and to a time like the time of their childhood—or of their ancestors' childhoods—an imaginary time, in which standing still is only an imaginary possibility.

Such are the dreams of a species defeated by nostalgia, at war with itself, with its migratory nature and the nature of its relationship to time, screaming in denial of the constant movement that is human life.

Perhaps thinking of us all as migrants offers us a way out of this looming dystopia. If we are all migrants, then possibly there is a kinship between the suffering of the woman who has never lived in another town and yet has come to feel foreign on her own street and the suffering of the man who has left his town and will never see it again. Maybe transience is our mutual enemy, not in the sense that the passage of time can be defeated but rather in the sense that we all suffer from the losses time inflicts.

WE ARE TOLD NOT ONLY THAT MOVEMENT THROUGH GEOGRAPHIES CAN BE STOPPED BUT THAT MOVEMENT THROUGH TIME CAN BE TOO, THAT WE CAN RETURN TO THE PAST, TO A BETTER PAST.

A greater degree of compassion for ourselves might then become possible, and out of it, a greater degree of compassion for others. We might muster more courage as we swim through time, rather than giving in to fear. We might collectively be able to be brave enough to recognize that our individual endings are not the ending of everything and that beauty and hope remain possible even once we are gone.

Accepting our reality as a migratory species will not be easy. New art, new stories, and new ways of being will be needed. But the potential is great. A better world is possible, a more just and inclusive world, better for us and for our grandchildren, with better food and better music and less violence too.

The city nearest you was, two centuries ago, almost unimaginably different from that city today. Two centuries in the future it is likely to be at least as different again. Few citizens of almost any city now would prefer to live in their city of two centuries ago. We should have the confidence to imagine that the same will be true of the citizens of the world's cities two centuries hence.

A species of migrants at last comfortable being a species of migrants. That, for me, is a destination worth wandering to. It is the central challenge and opportunity every migrant offers us: to see in him, in her, the reality of ourselves. ▯

Mohsin Hamid is the author of four novels—*Moth Smoke, The Reluctant Fundamentalist, How to Get Filthy Rich in Rising Asia,* and *Exit West*—and a book of essays, *Discontent and Its Civilizations.* His writing has been translated into 40 languages, featured on best-seller lists, and adapted for the screen.

Things they carried

Recent migration waves have inspired many art and photography projects. Tom Kiefer made images of water jugs (left) and other items that migrants left behind at the U.S.-Mexico border. To reflect migrants' "hope for a better life," Kiefer calls the photo project "El Sueño Americano"—The American Dream.

PHOTO: TOM KIEFER, REDUX

REDUCING PLASTIC WASTE FROM FOOD CONTAINERS

PHOTOGRAPH BY **REBECCA HALE**

SOME 174 MILLION tons of plastic packaging is produced globally each year. Only 20 percent of it gets recycled, and what's not disposed of properly ends up in our environment. Single-use plastic containers and wraps protect food in transit and extend shelf life, but do they really need to last hundreds of years? Designers and engineers who think not are devising alternatives that can be easily cleaned and reused, degrade into compost, or—best yet—disappear as the product is consumed. —ELIZABETH ROYTE

Food packaging that's not single-use plastic

New container materials and forms are advancing from prototype to market.

1. TAKE OUT, TURN IN

In a design challenge at New York City's Pratt Institute, students folded black plastic sheets to make take-out containers that could be returned to a collection point, sanitized, and reused ad infinitum by a consortium of take-out chains.

2. UTENSILS AND ALL

Another team in the Pratt challenge used paperboard to make a boxlike food container with a fold-it-yourself fork-spoon combination that diners tear from a perforated edge. The whole kit would be compostable.

3. ECO-INSULATING

Packaged meal-kit services, which ship ingredients for home-cooked meals, are a $3.1 billion market that some analysts expect to increase through at least 2023. Instead of hard-to-recycle or nonrecyclable bubble film, ice packs, and plastic foam, some kits are cushioned and insulated with liners of heavy paper and ClimaCell, a bio-based foam that can be dissolved to cellulosic fiber in a pulping plant.

CONTAINERS NOT SHOWN:

GROWING BOWLS

A Swedish institute is testing a compressed, cellulose-based container that could grow with its contents. For example: Soupmakers could fill it with freeze-dried vegetables and spices. As diners add hot water, the container's origami folds stretch into a fully compostable bowl.

MELTING PACKS

Thanks to dishwasher and laundry soap "pods," consumers are used to products delivered in transparent ethylene-based polymers that dissolve in water. U.S. and European regulators have pronounced the polymers safe for food uses. A U.S. manufacturer says the disappearing packaging doesn't affect food's texture, smell, or taste. Some protein supplements now come in pods; in the future they may deliver portions of pasta, rice, oatmeal, and other foods cooked with hot water.

Learn more about plastic waste and take the pledge to reduce it at ***natgeo.com/plasticpledge.***

THIS ARTICLE ORIGINATED IN OUR SPONSORED FUTURE OF FOOD DIGITAL SERIES.

DISPATCHES
FROM THE FRONT LINES
OF SCIENCE
AND INNOVATION

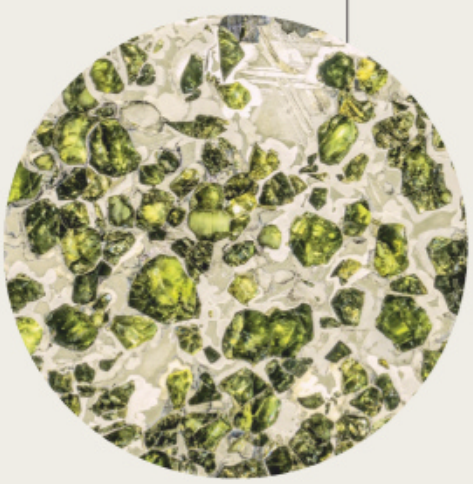
Bellyful of Stones

It's not unusual for crocodiles, alligators, and other crocodilians to have a stomach full of stones. Scientists have long assumed the stones help the semiaquatic reptiles digest prey; a new study suggests they also enable the crocs to spend more time submerged. –ANNIE ROTH

SPACE

Preserving Meteorites for Study

Rocks from space regularly rain down on our planet, but only a few survive the fall. At Arizona State University's Center for Meteorite Studies, some 40,000 meteorite remnants—such as the rare metal-and-crystal pallasite below—are stored in a humidity-controlled facility. The goal is to keep them free of contamination so future generations can study them for clues to how our solar system formed, and how we might one day survive in space.
–MAYA WEI-HAAS



BIODIVERSITY

PLANT'S POLLINATOR SECRETS REVEALED

MORE THAN ONE MOTH SERVES THIS RARE ORCHID

For exotic beauty, few flowers rival the ghost orchid *(Dendrophylax lindenii)*. These rare orchids have long nectar tubes into which moths stick their tonguelike proboscises to reach a sugary reward. As they feed, moths rub against a pollen source and pick up grains they'll transfer to other orchids they visit.

It's long been thought that only one insect, the giant sphinx moth, had a long enough proboscis to pollinate these orchids—but new images and research refute that. Photographers Carlton Ward, Jr., and Mac Stone, working with biologists Mark Danaher (of the U.S. Fish and Wildlife Service) and Peter Houlihan, spent years preparing and fine-tuning remote cameras. The payoff: photos of two other moth species with pollen on their bodies visiting ghost orchids in Florida parks (above, a streaked sphinx in Florida Panther National Wildlife Refuge). Meanwhile, new measurements suggest that even more moth species may be able to reach the orchid's nectar. "It's incredible," Ward says, to make a discovery about this "symbol of hidden wildness." –DOUGLAS MAIN

PHOTOS (FROM TOP): JOEL SARTORE, NATIONAL GEOGRAPHIC PHOTO ARK; CARLTON WARD, JR.; LAURENCE GARVIE, CENTER FOR METEORITE STUDIES, ASU

NATIONAL GEOGRAPHIC

YOU KNOW WHAT NATIONAL GEOGRAPHIC LOOKS LIKE.

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INTRODUCING OVERHEARD AT NATIONAL GEOGRAPHIC

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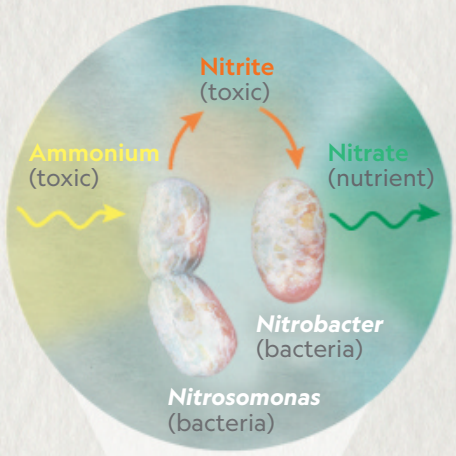
IN THIS SECTION
A Tough Tower Climb
Shaped for Surfing
Peace Like a River

ILLUMINATING THE MYSTERIES—AND WONDERS—ALL AROUND US EVERY DAY
NATIONAL GEOGRAPHIC | VOL. 236 NO. 2

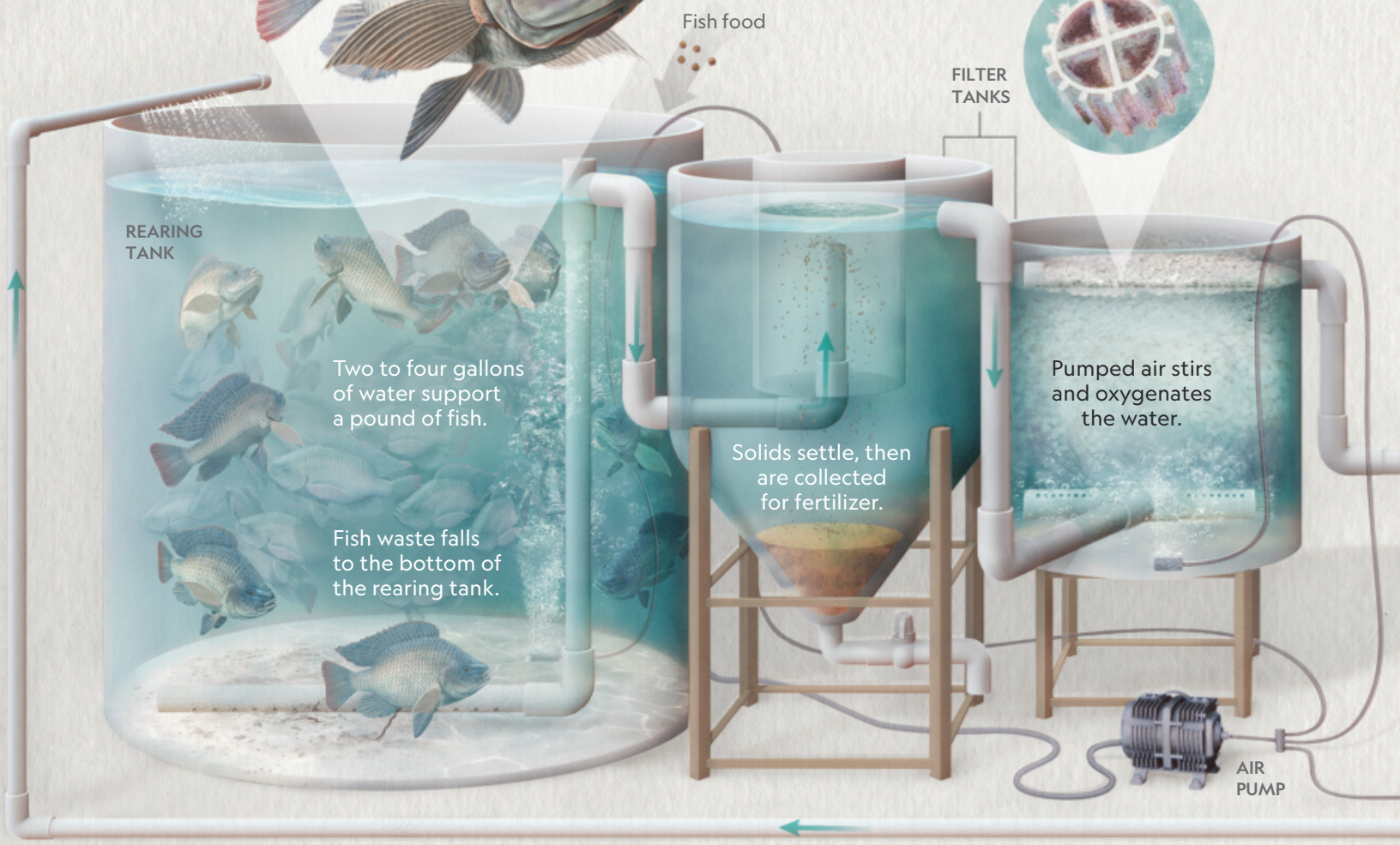
FROM TANK TO TABLE

VEGETABLES GROWN THROUGH AQUAPONICS—a combination of fish farming (aquaculture) and plant cultivation without soil (hydroponics)—may be coming to a marketplace near you. Practiced by the ancient Chinese and by the Aztec, the ever evolving technique is going commercial in Europe, Canada, and the U.S. It's being eyed as a sustainable farming option well suited to cities, islands, and developing regions where water and land are in short supply.



Plastic pieces are added to provide surface area for naturally occurring bacteria to grow on.

Tilapia (*Oreochromis aureus*)


Fish food
FILTER TANKS
REARING TANK
Two to four gallons of water support a pound of fish.
Fish waste falls to the bottom of the rearing tank.
Solids settle, then are collected for fertilizer.
Pumped air stirs and oxygenates the water.
AIR PUMP

1 Fish, such as the highly adaptable tilapia, excrete toxic ammonia in liquid waste.

2 Solid waste is filtered out; it can be used as fertilizer for crops grown traditionally in soil.

3 A two-step bacterial process turns harmful ammonia into nitrates, nutrients for plants.

SMALL-FOOTPRINT FARMING

Commercial aquaponic systems can yield up to 12 times as much produce per square foot as crops grown in soil—a boon to areas with limited freshwater and arable land. Current research focuses on reducing energy use and incorporating automation.

DECODER

BY **MONICA SERRANO**

LEDs that glow with a purple mix of red and blue promote growth and can provide more hours of light than sunlight.

Leafy crops are easiest to grow aquaponically and include lettuce, herbs such as basil and mint, and medical cannabis.

4 Seedlings are moved from nurseries to rafts atop soil-free grow beds up to 18 inches deep.

5 Plants immersed in flowing, nutrient-rich water can grow twice as fast as land crops.

6 About 98 percent of water, now free of toxic ammonia, circulates back to fish-rearing tanks.

ALEXANDER STEGMAIER. ART: DAVID KILLPACK. SOURCES: DONALD BAILEY, UNIVERSITY OF THE VIRGIN ISLANDS; HYE-JI KIM, PURDUE UNIVERSITY

BY THE NUMBERS

213

HEIGHT OF TOTEM POLE, IN FEET

10+

AVERAGE RAINY DAYS IN SEPTEMBER

1968

YEAR THE ROCK WAS FIRST CLIMBED

The Totem Pole is in Tasman National Park, Tasmania, Australia.

A PRECARIOUS

At an iconic climbing spot in Tasmania,

‘IF ANY OF US HAD FALLEN IN, IT WAS A GUARANTEED FATALITY WITH THOSE CONDITIONS.’
—Krystle Wright

POINT OF VIEW

a photographer waits for the perfect moment to fulfill a dream.

BY **NINA STROCHLIC** PHOTOGRAPH BY **KRYSTLE WRIGHT**

THE IDEA TO SHOOT an ascent of the Totem Pole, a stone tower in Tasmania, came to adventure photographer Krystle Wright in a dream. Years later, as she dangled from a line she’d rigged across nearby rocks, with a drone lighting the scene from above, she finally got her shot.

THREE MONTHS OUT

AN UNSEEN ROUTE

Jutting from the waters along the Tasman Peninsula, the Totem Pole is one of the world’s most dramatic column climbs. The sea stack is often photographed from the more accessible north side; Wright wanted to capture a southern ascent along a route called the Sorcerer. Climber Mayan Smith-Gobat would have to descend the neighboring rock face and swing herself across a channel on a rope to grab a handhold. Wright, Smith-Gobat, and a film crew plotted for months how to complete and document the climb.

ONE WEEK OUT

ESSENTIAL PACKING LIST

Supplies for rock climbing, swimming, and photography filled two bags. The stormy Tasmanian weather required backup down jackets.

- Flippers (“a very unique accessory to a climbing harness”)
- Drone with remote-operated flash
- Nearly 700 feet of rope
- Dry bag for crossing the channel with camera equipment
- Dry clothes to change into after swimming
- The only thing missing, says Wright, was “sanity.”

LAUNCH

READY TO SHOOT

After two days of trials and setup, Wright drove to the peninsula, hiked two hours on a trail, rappelled a 330-foot cliff, tied a rope around her waist, jumped into the ocean, swam across the channel, and climbed up the other side. Clipping herself into a harness, she hung from a tightrope as Smith-Gobat scrambled up the Totem Pole. At the “blue hour”—around 5:30 p.m.—Wright radioed the drone operator. When a flash from the drone overhead illuminated the rock, she pressed the shutter.

TERRY MARTIN CARVED HIS FIRST SURFBOARD at age 14, and tens of thousands more during the next 60 years. That put him in the elite ranks of the board artisans known as shapers (*Surfing Magazine* recognized just 720 of them in the past 100 years). Since Martin's death in 2012, his son Josh, bottom right, has carried on the tradition. Today's shapers craft surfboards with modern materials such as polyurethane foam or with wood such as the balsa and coast redwood (the stripe) seen here. Josh fashions boards for world-class competitive surfers, using tools that he and his dad once shared. –PATRICIA EDMONDS

1. Power planer
A shaper's primary tool, this planer creates the board's tapered silhouette and "rocker," the curve that makes nose and tail slightly higher than the middle.
2. Outline template
A wooden pattern that preserves a custom board or fin design so a shaper can produce it again.
3. Calipers
To measure the thickness of boards and the fins that go on their undersides.
4. Sanding block
Terry Martin smoothed so many surfboards with this hand-sanding tool that his fingers wore marks in its balsa wood handle.
5. Surform tool
Aka surface-forming tool, its graterlike metal face levels wood or foam.
6. Worktable, resin
Once carved, boards are coated with waterproof resin; the plywood catches drips, like this aqua-tinted resin from a custom board.
7. Ketchup bottle
Josh Martin says it's ideal "for squirting glue on wood like you'd squirt ketchup on a hot dog."
8. Power sander
A power sander quickly smooths and flattens large areas on longer boards.
9. Rail contour templates
Cutouts record the shape at the midpoint on a board's edge, as a reference to create the customer's next board.
10. Shaper's square
For marking board width and fin placement points, to be sure the halves of the board are symmetrical.
11. Tongue depressors
To mix and apply epoxies, pigments, and glues.
12. Block plane
A plane fine-shapes wood boards and shaves the stringer (the band of wood down a board's center) so it's level with the surface.

SHAPED TO CATCH A WAVE

PHOTOGRAPH BY **MARK THIESSEN**

Peace Like a River

A PHOTOGRAPHER WHO HAS PLUNGED INTO SOME OF AFRICA'S MOST TURBULENT ENVIRONMENTS FINDS SOLACE WHILE FLY-FISHING IN KENYA'S LUSH HIGHLANDS.

STORY AND PHOTOGRAPHS BY **PETE MULLER**

IT'S LAST LIGHT IN THE VALLEY, and the sound of rushing water drowns out all others. I walk the river's edge with my dog, Mosi, whose inability to hear over the cascade makes him nervous. Despite his impressive size, he trots sheepishly at my heels. Ostensibly we walk to fish, but really we move at the urging of naturalists long since passed—of John Burroughs and John Muir, of Loren Eiseley—and of my parents, Norman and Paula, who are alive today but live far from this Kenyan vale. Walk in the woods, their voices advise, along the banks of a river where, in the blue end of a day, you may find the rhythms that elude you. There, among the fish and the flowers and the forces that bind them, you might make peace with your worried mind.

I began to venture into the highlands of central Kenya in 2013 with the hope that its rivers might exert their transformative power upon me, smoothing my edges as they have, over time, polished the stones in their path. I've never been free of emotional distress, but my years of working as a photojournalist in some of Africa's most conflict-ridden environments left additional barbs in me. With time it became hard to differentiate between the conflicts that raged within and the ones I witnessed through my lens. Gradually they became intertwined, and I felt an expanding sense of tension and discomfort in my core.

Fly-fishing, with its knot-tying, wading, and

rhythmic casting, seemed an antidote to the pain of photographing suffering, as I'd done so often in recent years. I hadn't cast a fishing line since the age of 10 or so, when I used bait and lures to fish the Atlantic waters that surrounded the places I lived as a child, first along the coast of New Jersey and later in Massachusetts. My mother's boyfriend at the time taught me the basics. He was a large, avuncular man who'd been an interrogator in the U.S. Army Special Forces, an experience that left him with his own scars. As he affixed lures to his line, he explained that he could handle little more than fishing and taking photographs, the latter his chosen profession after leaving the military. At dusk along the jetties, his hand resting comfortably on the rod, he seemed at ease.

Between assignments I began to drive from the chaos of Nairobi, where I lived, to the fertile, undulating hills that surround central Kenya's Ragati and Mathioya waterways. The slow-flowing Ragati River drifts through protected indigenous forest, where a network of paths, used by humans, leopards, elephants, and buffalo, cuts through lush vegetation. The Mathioya rushes through the heartland of Kenyan tea production, near the slopes of the Aberdare Mountains and the receding glacial peaks of Mount Kenya. Both rivers are home to populations of furtive brown and rainbow trout maintained through the stocking

programs of the few nearby fishing clubs and lodges.

I frequented a simple cottage on the bank of the Mathioya where the sounds of the river are always present. There I followed John Ngaii Moses, a nimble man who, at the age of 57, moved across wet stones with the grace and confidence of someone younger. John's life began when the valley's beauty was tainted by conflict and injustice. He was born in 1961 above the river in the village of Kiamuturi, where his mother was confined when British colonists seeking to suppress an armed independence movement detained around a million Kenyans. His story reminds me that violence and cruelty can be inflicted in the most serene of places.

Near the village, John pointed to calm pools where fish linger and feed. I waded in, moving cautiously amid the rocks and swift currents, and cast my line. On my first visits I knew nothing of the principles of fly-fishing: about the presentation of the fly, about keeping the line taut while allowing it to float freely enough that fish mistake the artificial fly for a real one caught in the current. I believed, as most do, that the difficulty of fly-fishing lay in its famous back-and-forth casting. In fact, fly-fishing is a complex study of both technique and ecology, requiring knowledge of the rhythms of the river and how fish feed in order to effectively trick fish in one of their most basic skills.

As John and I traversed the river, I realized we had different definitions of fly-fishing. John prefers to catch fish rather than spar with them and so sometimes baits his line. His method is effective, but for my more meditative aims, I decided to pursue a slower and far less fruitful approach. John could teach me about the river, about its history and ecology, but the subtleties of technical fly-fishing would be my own challenge.

So began a period of quiet study, through books and websites, trial and error, in the graceful, patient art. I made nearly a dozen trips to the rivers of central Kenya before I felt even a nibble from the trout below. But despite my initial lack of success, my excursions created both ease and excitement within me. As I'd walk and cast, and sit and write, I understood that the hooking of fish was an excuse to explore and observe. To notice the sweet, enveloping scent of angel's trumpet blooms as the sun begins to set behind the hills. To watch pairs of black African ducks surf the current as the midmorning sun chases out the mist. To once again consider things bigger and smaller than I am.

And as the fish began to take my flies, I came to know that the rivers had given me more than I'd asked. I'd arrived in search of peace and a pastime, a counterweight to the stresses in my life. But as I waded in the eddies, in a cathedral of mist and wood and leaves, I felt connected, as I did on the summer days of my childhood, when sand sharks and puffer fish made my heart beat with curiosity and wonder. □

Pete Muller is a National Geographic storytelling fellow who is using photography and ethnographic research to explore the emotional impacts of environmental degradation.

Recently caught rainbow trout lie along the bank of the Mathioya. Photographer Pete Muller enjoyed the quiet process of learning to fly-fish, which was fortunate as it took him many tries before he managed to hook his quarry.

A WORLD ON THE MOVE

On Migrants' Paths ... P. 40
Rohingya Babies..... P. 64
Africans in Spain.....P. 74
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FEATURES

PHOTO: TURJOY CHOWDHURY

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IN THE WORLD'S LARGEST REFUGEE CAMP (COX'S BAZAR, BANGLADESH), ROHINGYA CHILDREN 'START LIFE IN A LEGAL LIMBO, CONSIDERED NEITHER BANGLADESHI NOR BURMESE BY BIRTH.'

WALKING WITH MIGRANTS

TRACING HUMANKIND'S JOURNEY FROM AFRICA, PAUL SALOPEK IS CHRONICLING A STORY FOR THE AGES: THE MASS MIGRATIONS IN WHICH MILLIONS OF PEOPLE ARE SEARCHING FOR A BETTER PLACE.

BY PAUL SALOPEK

PHOTOGRAPHS BY JOHN STANMEYER

WALKING WITH

ETHIOPIA 2013
Following our forebears
Paul Salopek (at left) and his guide Ahmed Elema begin day two of the author's global odyssey at the village of Herto Bouri, where the first people considered anatomically modern abandoned their familiar African horizon to explore the unknown world.

DJIBOUTI 2013
The ultimate risk
Migrants are intercepted and detained by the Djiboutian Coast Guard after trekking from Ethiopia, Somalia, and Eritrea and paying boat captains to carry them across the Red Sea to seek work in Yemen, Saudi Arabia, and beyond. Every year hundreds die during this journey.

A WORLD ON THE MOVE

FOR NEARLY SEVEN YEARS I have been walking with migrants. ¶ In the winter of 2013 I set out from an ancient *Homo sapiens* fossil site called Herto Bouri, in the north of Ethiopia, and began retracing, on foot, the defining journey of humankind: our first colonization of the Earth during the Stone Age. ¶ My long walk is about storytelling. I report what I see at boot level along the pathways of our original discovery of the planet. From the start, I knew my route would be vague. Anthropologists suggest that our species first stepped out of Africa 600 centuries ago and eventually wandered, more or less aimlessly, to the tip of South America—the last unknown edge of the continents and my own journey's finish line. We were roving hunters and foragers. We lacked writing, the wheel, domesticated animals, and agriculture. Advancing along empty beaches, we sampled shellfish. We took our bearings off the rippling arrows of migrating cranes. Destinations had yet to be invented. I have trailed these forgotten adventurers for more than 10,000 miles so far.

DJIBOUTI 2013
Search for a signal
Migrants in the Horn of Africa gather in darkness on Djibouti city's Khorley Beach. Using black-market data cards for their phones, they hope to capture a cell signal from neighboring Somalia to keep in touch with loved ones they've left behind.

Today I am traversing India.

Our modern lives, housebound as they are, have changed almost beyond recognition since that golden age of footloose exploration.

Or have they?

The United Nations estimates that more than a billion people—one in seven humans alive today—are voting with their feet, migrating within their countries or across international borders. Millions are fleeing violence: war, persecution, criminality, political chaos. Many more, suffocated by poverty, are seeking economic relief beyond their horizons. The roots of this colossal new exodus include a globalized market system that tears apart social safety nets, a pollutant-warped climate, and human yearnings supercharged by instant media. In sheer numbers, this is the largest diaspora in the long history of our species.

I pace off the world at 15 miles a day. I mingle often among the uprooted.

In Djibouti I have sipped chai with migrants in bleak truck stops. I have slept alongside them in dusty UN refugee tents in Jordan. I have accepted their stories of pain. I have repaid their laughter. I am not one of them, of course: I am a privileged walker. I carry inside my rucksack an ATM card and a passport. But I have shared the misery of dysentery with

The nonprofit National Geographic Society, working to conserve Earth's resources, helped fund this article.

JORDAN 2013
Escaping civil war
Refugees who fled their homes in Syria when fighting started in 2011 travel around Jordan to find work wherever they can—here picking tomatoes in Gowera village, just north of Aqaba.

them and have been detained many times by their nemesis—police. (Eritrea, Sudan, Iran, and Turkmenistan have denied me visas; Pakistan ejected me, then allowed me back in.)

What can be said about these exiled brothers and sisters? About the immense shadowlands they inhabit, paradoxically, in plain sight?

Hunger, ambition, fear, political defiance—the reasons for movement are not truly the question. More important is knowing how the journey itself shapes a different class of human being: people whose ideas of "home" now incorporate an open road—a vast and risky tangent of possibility that begins somewhere far away and ends at your doorsill. How you accept this tiding, with open arms or crouched behind high walls, isn't at issue either. Because however you react, with compassion or fear, humankind's reawakened mobility has changed you already.

IN DJIBOUTI
I HAVE SIPPED CHAI WITH MIGRANTS
IN BLEAK TRUCK STOPS.
I HAVE SLEPT
ALONGSIDE THEM IN
DUSTY UN REFUGEE TENTS
IN JORDAN. I HAVE HEARD
THEIR STORIES OF PAIN.

THE FIRST MIGRANTS I encountered were dead. They lay under small piles of stones in the Great Rift Valley of Africa.

Who were these unfortunates?

It was difficult to know. The world's poorest people travel from many distant lands to perish in the Afar Triangle of Ethiopia, one of the hottest deserts on Earth. They walk into these terrible barrens in order to reach the Gulf of Aden. There the sea is the doorway to a new (though not always better) life beyond Africa: slave-wage jobs in the cities and date plantations of the Arabian Peninsula. Some of the migrants' graves doubtless contained Somalis: war refugees. Others likely held deserters from Eritrea. Or drought-weakened Oromos from Ethiopia. All had hoped to sneak across the unmarked borders of Djibouti. They became lost. They collapsed under a molten sun. Sometimes they dropped from thirst within sight of the sea. The columns of exhausted travelers walking behind hastily buried the bodies.

How long have we been depositing our bones like this on the desolate trails of the African Horn? For a long time. From the very beginning. After all, this is the same corridor used by the first modern humans to exit Africa during the Pleistocene.

One day I stumbled across a group of scarecrows hiding in the scant shade of some boulders—15 lean Ethiopian men who seemed to pretend that if they didn't move a muscle, they would be invisible. Some were manual laborers. Most were farmers from the Ethiopian highlands. The annual rains, the farmers said, had become impossibly erratic. Sticking it out on their sun-cracked fields meant slow starvation. Better to chance the ocean of white light that is the Afar Triangle, even if you never returned. They were pioneers of sorts, new climate change refugees.

A recent World Bank study calculates that by 2050 more than 140 million people in sub-Saharan Africa, South Asia, and Latin America could be tumbled into motion by the catastrophic effects of climate change. Ten million climate refugees could swell the trails of East Africa alone. In Ethiopia the tide may reach 1.5 million people—more than 15 times the emigrants now straggling annually through the Afar Triangle to reach the Middle East.

Inching north up the Rift, I was forced to consider the urge to leave a familiar world that was falling apart, a home where the sky itself was against you. All around me snaked the invisible battle lines of an intensifying range war between the Afar and Issa pastoralists—two competing herder groups whose shallow wells were drying up, whose pastures were thinning from a relentless cycle of droughts. They shot at each other over the ownership of a papery blade of grass, over a cup of sandy water. In other words, over survival. Here was the source of our oldest travel story. Drastic climate change and murderous famines, experts say, likely helped drive the first pulses of humans out of Africa.

How strong is the push to leave? To abandon what you love? To walk into the unknown with all your possessions stuffed into a pocket? It is more powerful than fear of death.

In the Afar Triangle I stumbled across seven unburied bodies. They were women and men clustered together. *(Continued on page 60)*

AMONG THE UPROOTED

Since starting his trek out of Africa in 2013, Paul Salopek has traversed 16 countries (shown below), all marked by large-scale movements of people. Millions of them are international migrants, traveling from one country to another, mostly to find work and improve their lives. Many others, though, are refugees, forced to leave homelands ravaged by war or environmental disaster.

Avoiding catastrophe
War has driven millions from their homes into neighboring countries. Syrians have fled to Turkey and Jordan, Afghans to Pakistan and Iran, and South Sudanese and others to Ethiopia.

Number of migrants, 2017

2 million

Total migrants
% of country's total population

Refugees

Saudi Arabia
12.2 million
37%
Saudi Arabia doesn't accept refugees, but migrant workers drawn to domestic service and construction jobs make up nearly 40 percent of the population.

4.9 million
6%
Syrians make up more than 98 percent of Turkey's refugee population.

3.6 million
20%
Kazakhstan has seen an influx of migrants to work in its booming construction industry.

5.2 million
0.4%

3.5 million

3.2 million
33.3%

3.4 million
1.7%

1.2 million
3.6%

188,973
16%
9,745
CYPRUS

2 mil.
23.6%
25,637

RUSSIA

259,241
2.6%
1,115

602
KAZAKHSTAN

78,200
2%
2,069
GEORGIA

AZERBAIJAN

Caspian Sea

Manata Pass
June 2016

Salopek's route

20
UZBEKISTAN

TURKMENISTAN

273,259
3.1%
2,516
TAJIKISTAN

200,294
3.3%
334
KYRGYZSTAN

TURKEY

Argıl
Oct. 2014

SYRIA

133,612
0.4%
75,927
AFGHANISTAN

A S I A

IRAN

IRAQ

CHINA

Abbottabad
March 2018

2.9 million
JORDAN

ISRAEL

Aqaba
Dec. 2013

KUWAIT

Persian Gulf

BAHRAIN

QATAR

U.A.E.

Refugee camp, center, or settlement

Faridkot, Punjab
July 2018

1.4 million
PAKISTAN

197,122

Salopek's route

R e d S e a

OMAN

A r a b i a n S e a

Varanasi, Uttar Pradesh
Feb. 2019

148
SAUDI ARABIA

INDIA

1.2 million
1.2%
889,397

YEMEN

116,089
12.1%
17,548
DJIBOUTI

G u l f o f A d e n

Ardoukôba lava field
April 2013

START, Afar Triangle
Jan. 2013

SOMALIA

Bengaluru (Bangalore)

ETHIOPIA

I N D I A N O C E A N

A F R I C A

Migration magnet
The strong economies of Arab countries in the Persian Gulf have made the region a top destination for migrant workers. Gulf states host nearly 14 percent of the world's foreign labor.

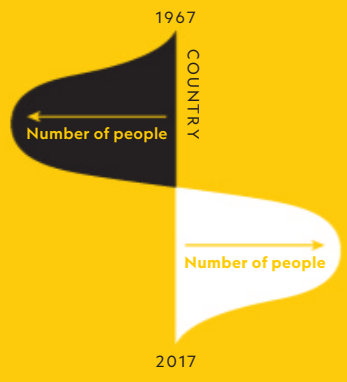
TAYLOR MAGGIACOMO AND RYAN WILLIAMS, NGM STAFF. SOURCES: UNHCR; UN DEPARTMENT OF ECONOMIC AND SOCIAL AFFAIRS; INTERNATIONAL LABOUR ORGANIZATION; INTERNATIONAL ORGANIZATION FOR MIGRATION

TURKEY 2014
Refuge from ISIS
Five-year-old Ahmed breaks down in tears after arriving safely in Turkey with his family. In a three-day period, some 150,000 Syrian Kurds entered Turkey at multiple places along the border to escape ISIS. Today Turkey harbors 3.7 million Syrian refugees.

TURKEY 2014
Stranded but sheltered
Rain clouds cast a shadow over Nizip 1, a camp where more than 30,000 Syrian refugees make do in tents provided by a Turkish governmental aid agency. Each unit has a small kitchen, bedding, and a TV. People share toilets and showers.

THE SHIFTING PATTERNS OF MOVEMENT

MIGRATION WAVES



WHEN EMIGRATION IS HIGHER
Black indicates more people leaving a country than foreign-born residents staying.

WHEN IMMIGRATION IS HIGHER
White indicates more foreign-born residents in a country than people leaving.

The ebb and flow of people across borders has long shaped our world. Data from the past 50 years of international migration help us understand why people make the choice to leave and where they go. Less than 10 percent of these migrants are forced to flee; most are seeking a better life and move only when they can afford to. Global migrants totaled fewer than 100 million in the 1960s, and although the number has increased substantially since then, it remains a fraction of the world's 7.6 billion people today.

258 MILLION PEOPLE IN 2017 LIVED OUTSIDE THEIR COUNTRY OF ORIGIN.

3% OF PEOPLE WORLDWIDE ARE MIGRANTS; THE FIGURE HAS HELD FOR 50 YEARS.

ALBERTO LUCAS LÓPEZ, RYAN WILLIAMS, AND KAYA BERNE, NGM STAFF

POVERTY IMMOBILIZES, MONEY MAKES MOVING POSSIBLE

Bangladesh. Millions fled conflict in the 1970s, and in the 1980s millions more began to leave for work in the Gulf states. Remittances from overseas fuel the economy.

Mexico. Higher incomes have encouraged many to seek U.S. jobs. Factors such as a weak U.S. market and stronger border enforcement after the 9/11 attacks slowed migration.

Vietnam. Economic growth since the end of the war, in 1975, has spurred in- and out-migration. Nearly half the four million Vietnamese living abroad are in the U.S.

STRONG LABOR MARKETS DRAW MIGRANTS

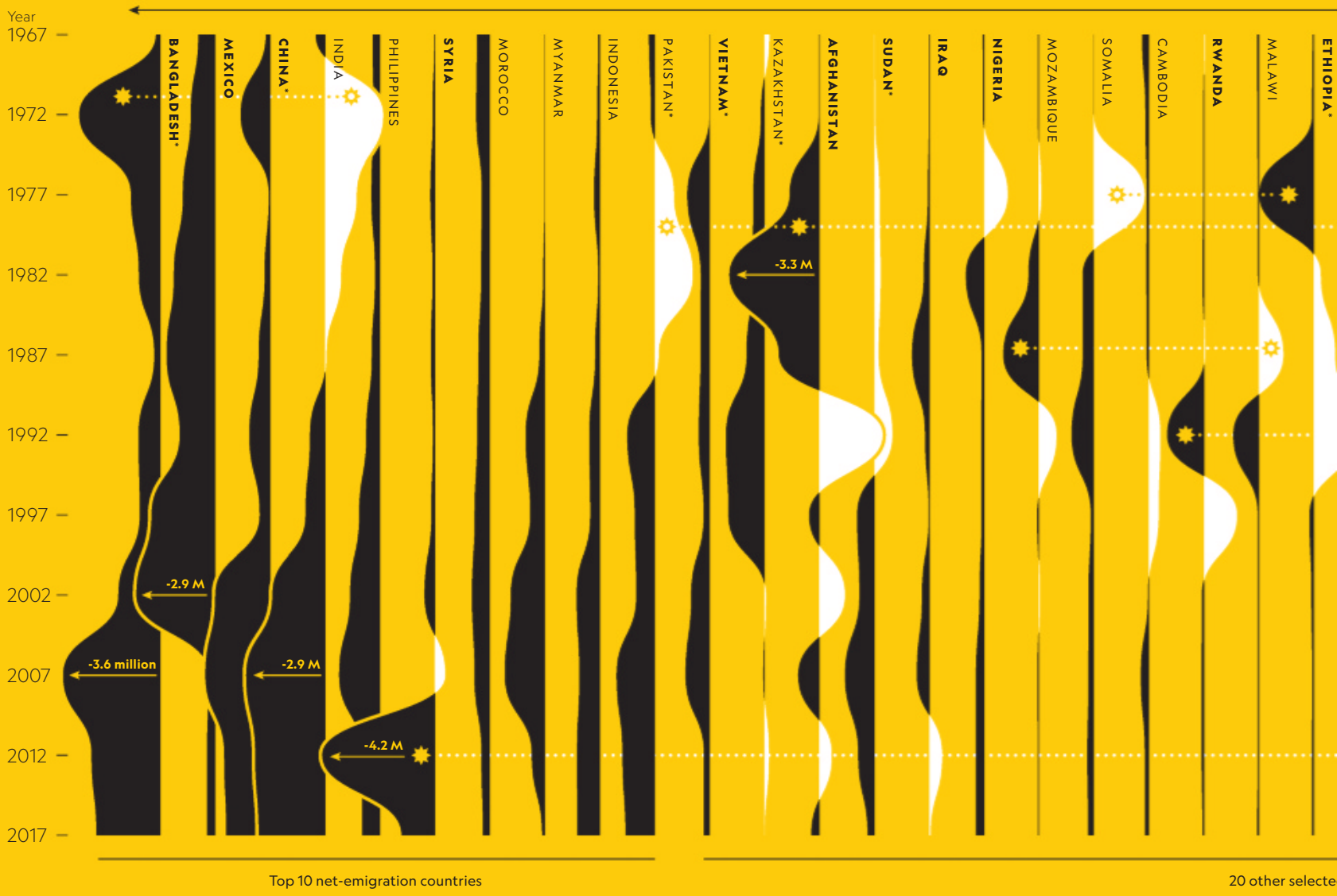
Thailand. Migrant workers and refugees are attracted to Thailand's wages and unfilled jobs. There was a brief outflow in 1992 of refugees who went home to Cambodia.

Spain. Economic growth, rising demand for labor, and integration into what became the EU led to a surge in migrants from developing countries in the 1990s.

Saudi Arabi oil boom br workers to t The 1990s sa revenues an on undocum

HIGHER EMIGRATION

More people leaving a country than foreign-born residents staying



Charts track net emigration (black) or immigration (white), 1967 to 2017.

Nation in conflict **Destination**

Larger refugee crises shown above

INSTABILITY FORCES PEOPLE OUT

Syria. Unrest and civil war have pushed millions into countries such as Turkey, Jordan, and Lebanon. Syria's outflow in 2012 is mirrored in Turkey's inflow.

Afghanistan. The Soviet Union's 1979 invasion sent millions into Pakistan and elsewhere in the region. Many later returned, only to face further violence.

Sudan. Refugees from neighboring countries have contributed to Sudan's inflows, but cycles of civil war in the mid-1990s created greater net outflows.

Iraq. Instability following the 2003 U.S.-led invasion displaced millions of Iraqis. More recently, Iraq has taken in some 250,000 refugees from war-torn Syria.

Nigeria. A v in the 1980s arrivals and departures. groups such are spurring

ia. The 1970s ought foreign he kingdom. aw dwindling oil d a crackdown nented migrants.

U.A.E. Oil wealth, political stability, and a construction boom in the 2000s drew foreign workers. But soon after that, when oil prices fell, many of them left.

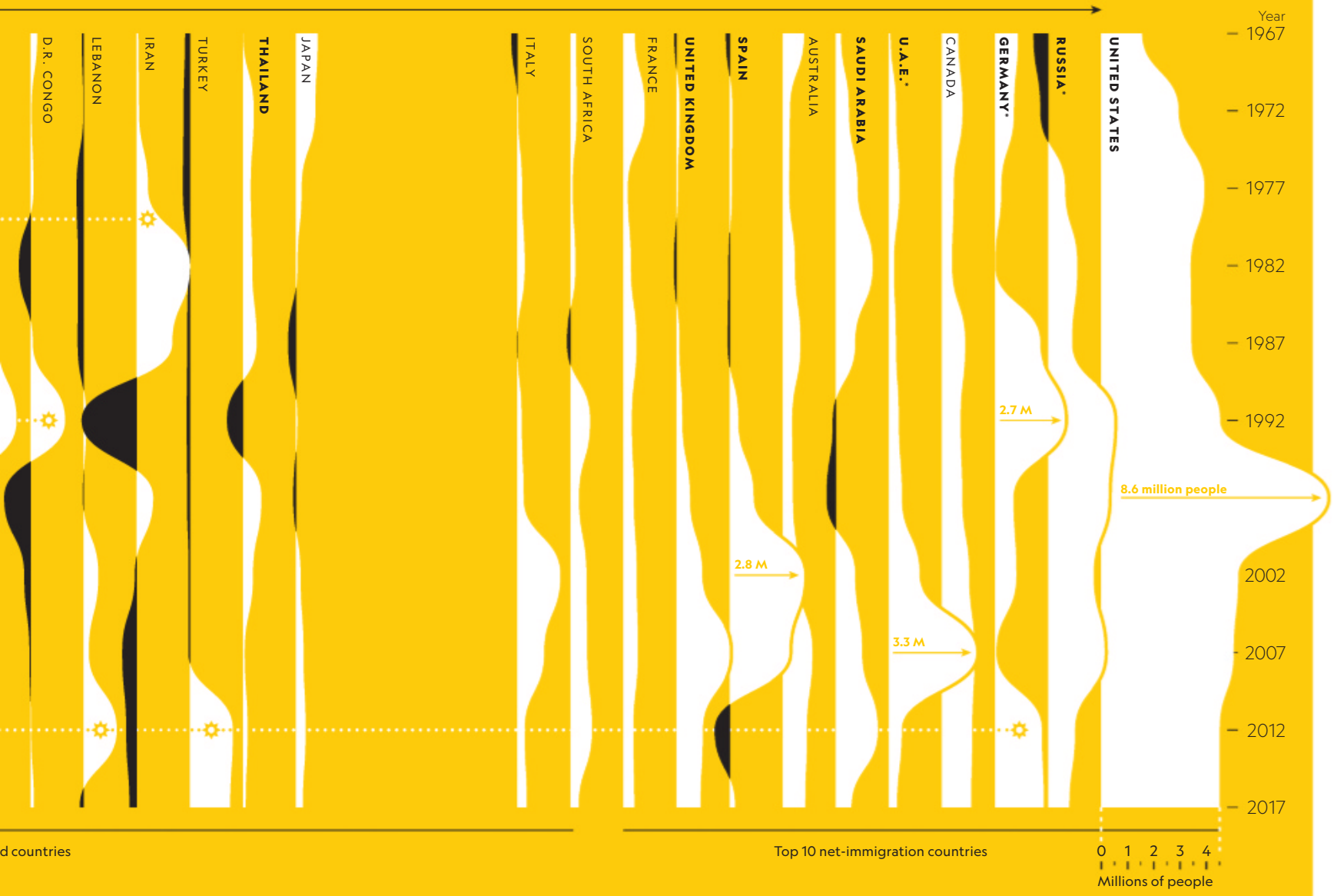
Germany. Millions of Eastern Europeans arrived when the Iron Curtain was lifted. The next surge came in the late 2000s as the robust economy drew migrants and refugees.

Russia. An exodus was reversed in the 1970s with the discovery of resources such as oil and gas. The 1991 Soviet collapse brought new arrivals from former republics.

United States. Some 1.6 million new jobs came with a strong postrecession economy in the 1990s. In 2002 a slowdown slashed both jobs and immigration.

HIGHER IMMIGRATION

More foreign-born residents in a country than people leaving



violent uprising curbed migrant prompted Today terrorist as Boko Haram outflow.

Rwanda. Nearly two million Rwandans fled during the genocide that took some 800,000 lives in 1994. The conflict fueled war in the Dem. Rep. of the Congo.

POLICIES SHIFT MIGRATION FLOW

China. An end to "whites only" policies overseas that had long blocked migration, and emigration reforms at home in the 1980s opened the world to Chinese workers.

Ethiopia. The government outlawed emigration in 1981 after famine and revolution forced people out of the country. Many returned once the regime fell, in 1991.

United Kingdom. A change in policies in the 1990s eased restrictions on immigration and asylum. By 2002, a skilled immigrant could get a visa without a job offer.

*NET MIGRATION DATA BASED ON CURRENT COUNTRY BORDERS. SOURCES: WORLD BANK; IOM; UNHCR; ILO; MIGRATION POLICY INSTITUTE; PEW RESEARCH CENTER; SONJA FRANSEN AND HEIN DE HAAS, INTERNATIONAL MIGRATION INSTITUTE

UZBEKISTAN
2017

On the move for work

Men driving from their homes in Uzbekistan to seek jobs in Russia pause to pay homage to Daud-Ota, revered in tradition as a patron and guardian, who is buried in a nearby necropolis.

They lay faceup, mummified atop a dark lava field. The heat was devastating. The little wild dogs of the desert, the jackals, had taken these travelers' hands and feet. My walking partner, Houssain Mohamed Houssain, shook his head in wonder, in disgust. He was an ethnic Afar, a descendant of camel herders, the old kings of the desert. His people called the recent waves of transients *hahai*—"people of the wind"—ghosts who blew across the land. He snapped a picture.

"You show them this," Houssain said angrily, "and they say, 'Oh, that won't happen to me!' "

One of the unlucky migrants had squeezed under a ledge. Doubtless he was crazed for shade. He had placed his shoes next to his naked body, just so, with one sock rolled carefully inside each shoe. He knew: His walking days were over.

WALKING THE CONTINENTS teaches you to look down. You appreciate the importance of feet. You take an interest in footwear. This is natural.

Human character, of course, is mirrored in the face. The eyes reveal sincerity, lying, curiosity, love, hate. But one's choice of shoes (or even lack of it) speaks to personal geography: wealth or poverty, age, type of work, education, gender, urban versus rural. Among the world's legions of migrants, a certain pedal taxonomy holds. Economic migrants—the destitute millions with time to plan ahead—seem to favor the shoe of the 21st century's poor: the cheap, unisex, multipurpose Chinese sneaker. War refugees escaping violence, by contrast, must trudge their wretched roads in rubber flip-flops, dress loafers, dusty sandals, high-heeled pumps, booties improvised from rags, etc. They flee burning cities, abandon villages and farms. They pull on whatever shoes lie within reach at a moment's notice. I first began to see such eclectic piles of footwear appearing outside refugee tents in the highlands of Jordan.

"I wake up to these mountains," cried Zaeleh al Khaled al Hamdu, a Syrian grandmother shod in beaded house slippers. Tiny blue flowers were

INDIA 2019
From farm to city
About 2,800 apparel workers, mostly women, are employed by Indian Designs Exports Private Limited, in Bangalore. More than 70 percent of such workers have left rural communities, mainly in northern India, for jobs in the city. The company manufactures clothing for Gap, Columbia, H&M, and other brands.

18+

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tattooed on her wrinkled chin and cheeks. She waved a bony hand at the alien peaks around her. "It feels like these mountains, I am carrying them on my back."

Heaviness. Weight. The crush of despair. The mountainous burden of helplessness.

This is the badge of the war refugee. Or so our televisions, newspapers, and mobile phones would inform us. The stock media photo of the war-displaced: columns of traumatized souls marching with heavy steps, with slumped shoulders, along a burning road. Or families jammed into leaky boats on the Mediterranean, their gazes sagging with anguish, sunk in vulnerability. But these snapshots of refugee life—seen through the lens of the rich world—are limited, misleading, even self-serving.

THE REFUGEES I HAVE WALKED AMONG ARE **SUPREMELY ORDINARY BEINGS** GRAPPLING WITH MEAGER OPTIONS BUT NOT POWERLESS. OFTEN **THEY ARE INCREDIBLY STRONG.** AND GENEROUS, DESPITE THEIR MISERABLE PRESENT.

For weeks I walked from tent to dusty tent in Jordan. At least half a million Syrians languished there—just one aching shard of some 12 million civilians scattered by the bloodiest civil war in the Middle East. War steals your past and future. The Syrians could not go back to the contested rubble of their homes—to Idlib, Hamah, or Damascus. Nobody else wanted them. They were stuck. All they owned was their miserable present.

Many toiled illegally on farms.

They eked out another breath of life by picking tomatoes for $1.50 a day. When I plodded past, they waved me over. They jauntily fed me their employers' crops. (Residents of a poor nation, Jordanians spared little affection for their even poorer Syrian guests.) They poured gallons of tea with wild thyme down my throat. They shook out their filthy blankets and bade me sit and rest.

"Here, we only dream of chicken," one man joked. He'd eaten grass to survive in Syria. In one tent a young woman stepped behind a hanging bedsheet and reemerged in her finest dress—pink with silver stripes. She was dazzlingly pregnant, and her beauty passed in a clean hush through my chest, into the moldering tent, before blowing unstoppably out into the desert.

What I'm trying to say is this: Whatever else refugees may be, they aren't powerless.

They aren't the infantilized victims usually featured in the political left's suffering porn. They resemble even less the cartoon invaders feared by right-wing populists and bigots—the barbarian hordes coming to take jobs, housing, social services, racial identity, religion, sex partners, and everything else vital and good in wealthy host countries. (Since Neolithic times, the earliest populations of Europe have been overrun and utterly transformed by waves of immigrants from Central Asia and the eastern Mediterranean. Without such interbreeding, modern "Europeans" wouldn't exist.)

No. The refugees I have walked among are bearded pharmacists and girl goatherds. Shopkeepers and intellectuals. That is, supremely ordinary beings grappling with meager options. Remembering their dead, they cup their hands to their faces and weep. But often they are incredibly strong. And generous.

"Please come, mister," a Syrian teacher whispered in Turkey, guiding me from a refugee camp classroom out into the open air. Her students had been drawing decapitations and hangings as part of their art therapy. She noticed I had fallen silent. She was worried about *my* emotions.

A thousand walked miles to the east, in the Caucasus, a family of ethnic Armenian refugees from Syria hollered, "Don't come in please!"—making me wait outside their dilapidated home while they hastily set a table they couldn't afford. They recently moved into a house that once belonged to ethnic Azerbaijanis, a local population ejected during the decades-old Nagorno-Karabakh conflict. I found the Azerbaijanis 120 miles later. They refused my money in a refugee camp café.

"We have been waiting for peace so long," Nemat Huseynov, the café owner, said. He had owned many sheep when the conflict began in 1988. It goes on, despite a cease-fire in 1994.

Huseynov stared at his big, work-swollen shepherd's hands splayed palm down on the worn tablecloth.

Home.

You cannot always choose your shoes on a long walk.

The world's refugees and migrants don't demand our pity. They just ask for our attention. Me they pitied because I walked on.

"MAY I PRACTICE my English?"

It was the teenage boys and girls of Punjab. Last year. Mile 7,000 of my slow journey. The scalding back roads of India's breadbasket.

Five, 10, 20 youngsters a day emerged from their houses, jogging to catch up after I slogged past. Sweating, puffing, unused to exercise, they unlimbered their English vocabulary and syntax for a few hundred yards before peeling off. They were studying for the International English Language Testing System exams. High scores were essential to meet the English-proficiency standards required for visas to New Zealand, Australia, the United Kingdom, Canada, and the United States. There was nothing lighthearted about these exchanges that were as old as the Stone Age—"Who are you?" "Where do you come from?" "Where are you going?"—because it was homework.

Faridkot was a town marooned in a sea of wheatgrass. About 100 private English-language schools there were preparing tens of thousands of young Indians to abandon their homeland. The fields of Punjab were already taken. There was little future in farming. Successful students aimed to join the 150 million migrant laborers who vault frontiers to find work. Punjab was undergoing an evacuation.

"The only ones who stay behind are those who can't afford it," said language-school owner Gulabi Singh, looking startled at his own information. The average cost of emigration: $14,000, or 23 times the annual median income in India.

I had just arrived from Central Asia. A walking partner in Uzbekistan slipped regularly into Kazakhstan to work without papers at construction sites. He carried scars from police encounters. In Kyrgyzstan and Tajikistan, I met migrants who flew to Moscow to punch cash registers or inhale poisons at nightmare chemical plants. The Afghans along my route were eyeing every continent to flee the war. And so on.

Yet here is the secret of this epic of human restlessness: It is probably the people who stay behind who will change the world.

Internal migrations—rural-to-urban stampedes—sweep up 139 million citizens within India. In China the figure approaches a quarter billion. In Brazil, Indonesia, Nigeria, Mexico, everywhere, the trend is the same. Three-quarters of the humans now stumbling across the planet are circulating within their own borders. New middle classes are being born. Old political dynasties are tottering. Megacities are exploding—and imploding. Stunning innovations collide with colossal disappointments. Entire systems of knowledge (traditional farming), accumulated over millennia, are being jettisoned. Urbanization is cracking apart old gender and religious norms. Environmental resources are in free fall. Chaos, longing, violence, hope, tearing down, building up, experimentation, astonishing successes and defeats. Nothing can stand in the way of this unprecedented force of yearning. By comparison, the hysteria in the global north over international migrants seems a pale sideshow.

Walking India, I joined human torrents streaming along roads. I saw them jamming bus stands. Packed atop trains. The hardworking poor ceaselessly coming and going. Sooner than later, the world must learn to harness the extraordinary energy behind such mass aspiration.

The migrant steering the course of our species' destiny this century saw me coming from afar. People always do. She couldn't have been 18. This was in a village of stray cows in Bihar, one of India's poorest states. I was bound for Myanmar. She strode up and boldly shook my hand.

"This place is very, very boring," the Bihari girl declared within a minute. "My teachers are boring. What do I do?"

I laughed.

Ambition and intelligence shone in her eyes. Soon enough she would be shouldering her way into one of India's metastasizing cities, testing her mettle against hundreds of millions of other dislocated villagers. There would be no wall high enough to contain her.

Where will she end up? Where will we? Nobody knows. The important thing on this road we share is to keep walking. And not be afraid. The way ahead may be uphill. I suggest doing your homework. Her shoes were sturdy. ▯

Follow National Geographic Fellow **Paul Salopek**'s walk around the world at *outofedenwalk.org* and *natgeo.com*. **John Stanmeyer** has been documenting parts of Salopek's journey for the magazine.

REFUGEES FROM THE START

AT THE WORLD'S LARGEST REFUGEE CAMP, IN BANGLADESH, DOZENS OF ROHINGYA BABIES ARE BORN EACH DAY WITH NO LEGAL CITIZENSHIP. WHAT DOES THE FUTURE HOLD FOR THEM?

BY **NINA STROCHLIC**
PHOTOGRAPHS BY **TURJOY CHOWDHURY**

REFUGEES FROM

Rubina
22 days old

TOROJIMAJI,
FROM KHERY PRANG, MYANMAR,
HOLDS HER DAUGHTER, RUBINA. NEITHER MYANMAR NOR
BANGLADESH, WHERE THEY CURRENTLY LIVE,
WILL GIVE THE ROHINGYA CITIZENSHIP.

Mohammed Noor
25 days old

Unnamed
15 days old

Riaj
25 days old

Shahed
7 days old

‘LOOKING AT THOSE INNOCENT EYES,

Unnamed
5 days old

Unnamed
15 days old

Unnamed
18 days old

Shohida
2 months old

Unnamed
1 day old

Yasir
1 month old

Shahida
2.5 months old

Naser
1 month old

I WAS THINKING, WHAT THE HELL IS GOING ON?'

Unnamed
26 days old

Ershad
2 months old

Yunus
1 month old

Unnamed
10 days old

JAHEDA,
FROM NASHAPUR, MYANMAR,
CRADLES HER ONE-MONTH-OLD BABY, NOOR KAYAS.
BOTH MOTHER AND BABY
ARE STATELESS.

A WORLD ON THE MOVE

THE CRYING INFANT was wrapped in a donated red blanket. She was one day old and didn't yet have a name. Shortly before she was born, her parents had joined the exodus of Rohingya refugees from Myanmar to what soon became the world's largest refugee camp, known as the Kutupalong-Balukhali settlement, in Cox's Bazar, Bangladesh. ¶ Photographer Turjoy Chowdhury was walking through the camps when he ducked into a small shack to find the source of a plaintive cry. As he snapped her photo, Chowdhury's head spun with the politics and persecution that had resulted in the scene before him: "Looking at those innocent eyes, I was thinking, What the hell is going on?" ¶ Rohingya children born in Cox's Bazar start life in a legal limbo. Because neither Bangladesh nor Myanmar offers citizenship to the Rohingya, they are stateless. ¶ For decades in the majority-Buddhist Myanmar, the Rohingya ethnic group—who are largely Muslim—have been considered foreigners, even though they've likely lived in Myanmar since at least the 15th century.

In 1982 Myanmar passed a law granting citizenship to its main ethnic groups. Later interpretations excluded the Rohingya and made proving their nationality nearly impossible. This allowed the government to give them temporary registration cards—not considered proof of nationality—rather than the necessary identity cards.

In August 2017 an attack on police stations by Rohingya militants sparked a crackdown by the Burmese military. Since then, more than 900,000 Rohingya, of an estimated million who lived in Myanmar, have fled into Bangladesh. Because Bangladesh doesn't recognize them as refugees, their movements are restricted, and they cannot access public services or become citizens. A repatriation deal between Bangladesh and Myanmar was struck in 2017, but conditions in Myanmar are still not safe for their return, human rights groups say.

Of the half million children living in Cox's Bazar, more than 30,000 are under the age of one, according to the UN. "The impact of being stateless creates great uncertainty for the future of Rohingya children," says Karen Reidy, a UNICEF spokesperson. "A child without any nationality can face a lifetime of discrimination."

A global "shift toward xenophobia" means statelessness, which currently affects 10 million people, may soon increase, says Amal de Chickera, from the Institute on Statelessness and Inclusion. "If you're stateless, it's not enough to ensure it's safe to go back [home]—you need a state to go back to."

Chowdhury's project, Born Refugee, shows the children as collateral damage of a conflict focused on ethnic identity. "One thing that comes to my mind all the time is John Lennon's song *Imagine,"* he says. "A borderless world: this is what the project is all about." ▯

NGM MAPS

DILNUAZ BEGUM, FROM BORGOJIBIL, MYANMAR, HOLDS HER 18-DAY-OLD BABY, WHOM SHE HAD NOT YET NAMED.

After making his way in 2016 from Senegal to the agricultural belt of southern Spain, Mbaye Tune settled into regular seasonal work on tangerine and other fruit farms. Now 25, he's landed legal residency and a rented apartment he shares with other Senegalese.

TENS OF THOUSANDS OF JOB-SEEKING AFRICANS JOURNEY TO EUROPE EACH YEAR. MANY WIND UP TRADING ONE HARDSHIP FOR ANOTHER.

BY **CYNTHIA GORNEY** PHOTOGRAPHS BY **AITOR LARA**

LEAVING AFRICA, FOR THE GAMBLE OF A LIFETIME

LEAVING AFRICA, FOR THE

Trained as an engineer, this 38-year-old Nigerian imagined Spain would prove the gateway to a better life in Europe. That was 14 years ago. Still migrating between Spanish planting and harvest jobs, he lives in a *chabola*, a shack that field-workers assemble from scrap wood and plastic.

A WORLD ON THE MOVE

WHEN YOUSSOUF WALKS in the southern Spanish town of Lepe, where he is living for now inside an abandoned slaughterhouse, he greets in passing the other Africans he recognizes: the Senegalese, the Nigerians, the men from Burkina Faso and Ivory Coast. He is fluent in French and has learned good Spanish, but with Malians like himself the exchanges are in Bambara, which requires more elaborate courtesies. *Is your extended family fine? Yes, they are well. Your close family is fine? They also are well. And your wife? She is well.* ¶ Youssouf likes to wear a short-brimmed hat and sunglasses outdoors. His clothes and shoes are clean whenever he's on the streets; there's hot water in the slaughterhouse, where aid workers have improvised a migrant shelter amid the concrete stalls. Youssouf helps keep order inside. Because of this, and because he knows how it feels when a man with ambition battles shame every morning—why a good son or husband or friend tells lies over the mobile phone to people he loves, a continent away—Youssouf makes

A decade into their new lives in Spain, Senegalese friends Fatou Ndoye, left, and Hawka Diallo prepare for a Senegalese holiday inside Ndoye's apartment in the town of Moguer. Diallo works picking berries; Ndoye and her husband have jobs in a fruit warehouse. The younger of the Ndoyes' two children, an eight-year-old girl, was born in Spain and is a standout at her public school.

This story was produced by *National Geographic* through a reporting partnership with the United Nations Development Programme.

it a point to sit with newcomers in the shelter's common rooms, just keeping them company.

The guy today was a Malian named Lassara. He had a melancholy face and sat at a table in the makeshift kitchen, alternately staring at a cell phone and slumping over to rest his head on his arms. "The next harvests haven't started here yet," Youssouf said. "So he has no work."

Lassara had been in Spain for eight months. Youssouf, who's been in Spain for 14 years, calls Lepe a *carrefour*, a crossroads. He means both a stopping place and a confusion of alternate pathways. The pull and push of modern global migration makes carrefours of places no one could have imagined a few decades ago, and here in this plain little agricultural town, Youssouf wondered how many times he had listened to young men like Lassara tell stories exactly like his own: the first resolution to leave home, as neighbors kept passing on reports of their admirable distant relatives enjoying fine lives while sending support money from afar. The conviction that despite breaking immigration laws—paying a thousand euros or more to be smuggled northward country by country and by the grace of God or Allah surviving the illicit open-boat crossing from Morocco to Spain, the European landmass closest to Africa—a migrant laboring hard in Spanish fields will somehow obtain a work permit and land a steady job and make home visits properly, on an airplane, to embrace those relatives who were supposed to have been the whole point of their leaving.

Lassara raised his head, said something in Bambara, and Youssouf translated into Spanish: "Nobody talks about what it's really like."

Youssouf watched him bury his face again and nodded. Nearly 60,000 people hazarded the Mediterranean crossing last year, following northward routes mapped by rumor and smugglers. But in carrefours all over the world, migrants talk to each other in this way, trading

SUTERÍA

At an entrance to Madrid's historic Plaza Mayor, Senegalese migrants take a break from their labors for an autumn celebration of drumming, singing, and prayerful thanks. In urban Spain, many Africans have been unable to obtain formal work permits. A popular alternative: peddling merchandise on blankets that can be whisked away when police show up. The salesmen are called *manteros*, blanket men.

hope, disappointment, tenacity, pain. Youssouf has a teenage daughter he hasn't seen since she was an infant, and a son he's seen only in pictures; his wife was pregnant with the boy when Youssouf left the Malian capital, Bamako. None of them know he sleeps in a former slaughterhouse. When he spent a decade sleeping in a succession of *chabolas*, the shacks migrants build with plastic sheeting and scrap wood dragged from the berry fields, they didn't know that either. This is why he asked to be identified by first name only.

HIS FAMILY BACK IN MALI DOES NOT KNOW THAT HE SPENT A DECADE **SLEEPING IN SHACKS,** OR THAT HIS LIFE IN SPAIN HAS BEEN SO DIFFICULT. **'NONE OF US ARE GOING TO TELL** OUR FAMILIES ABOUT IT. ALL OF THIS IS A SECRET.'

"There are secrets each of us has to keep," he said.

Youssouf waved a hand at their surroundings: the battered couch; the weedy broken concrete outside; the cemetery up the street, where a half acre beside the graves now holds so many chabolas that when people in Lepe say *el cementerio*, they usually mean the migrants' slum. "All of this," Youssouf said. "None of us are going to tell our families about it. All of this is a secret."

I'M FINE. THINGS ARE GOOD HERE. *Make sure Ma doesn't worry.* How much human migration over the centuries has been propelled partly by protective shading of the truth? And how much more efficient, here in the 21st century, to dispatch the reassuring report via mobile phone? A few years ago World Bank economists figured out that the world's poorest households were likelier to have access to a mobile phone than to a toilet. Inside Lepe's chabolas, the furnishings are scraps and discards, but nearly everybody has a phone. Some of the phones have cameras, and attractive backdrops are abundant for the selfie sent home: a stranger's parked convertible, a bar's television, the kitchen of an acquaintance who's managed to rent an indoor room in town.

Lepe is not historically a migrants' carrefour. It's part of a southern Spanish crescent of coast that in recent decades has been transformed, through intensive irrigation and greenhouse farming, into an abundant multiseason agricultural belt. Lepe's berries and citrus ship throughout Europe, and back when the farms were expanding, as growers ran out of Spaniards willing to accept field hours and wages, they turned to outsiders for labor—Moroccans and Eastern Europeans at first, some hired by contractors who delivered work papers as part of the deal, some arriving illegally and hustling jobs on their own. Men and women came by the hundreds; growers with berries to pick favored the women's more delicate hands. Shopkeepers put up signs in Polish, Romanian, Arabic. Butchers began offering halal meat.

And the word kept spreading, to more places poorer and tougher than Spain: a chance. At what? "At searching ... for my life," Youssouf said, pausing to answer in a way that satisfied him. "I'd heard from all these people who'd gone to Spain. That it was easy to get to. That they had a life better than ours."

In fact he once imagined he would find his life in France: A French-speaking African sets off for Europe assuming he will land for a while in southern Spain, recuperating and marshaling resources to proceed north. Then things happen, one field gig leads to another, deceptive employers promise papers but don't come through, rental apartments are pricey and scarce for dark-skinned foreigners who want many roommates for rent sharing so they all can keep sending money home.

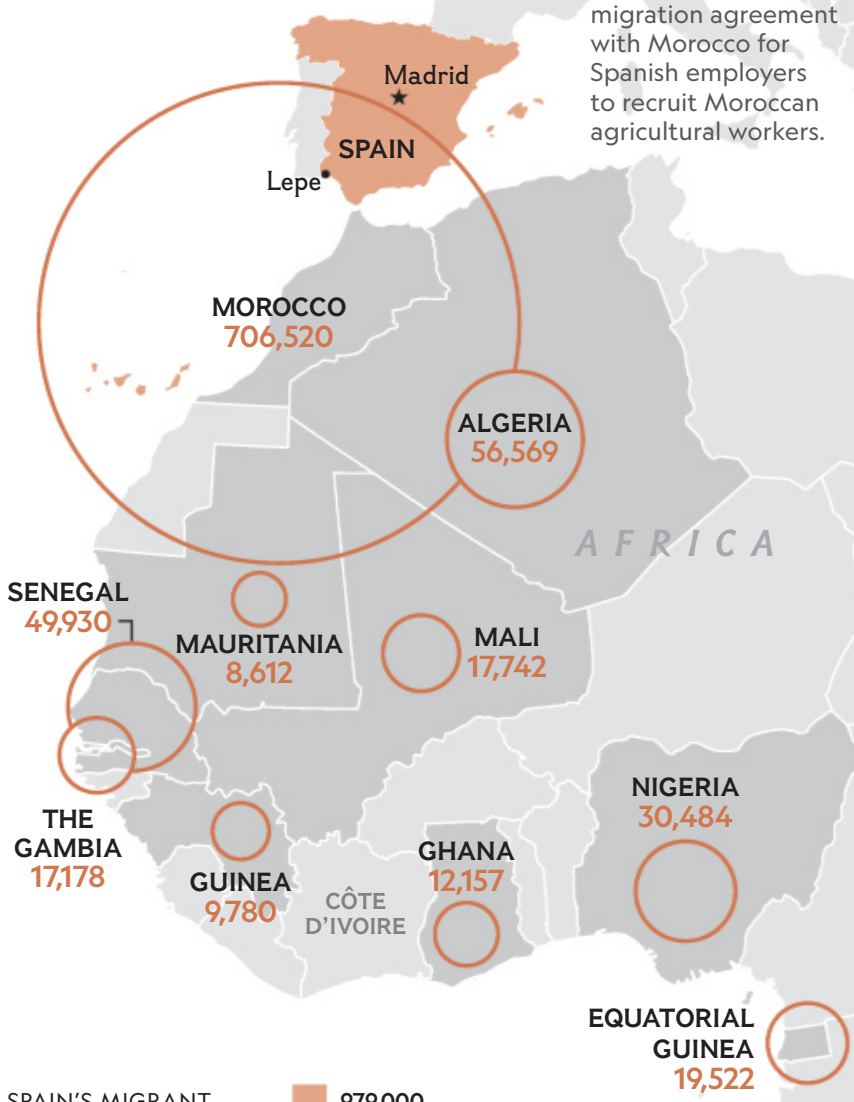
As he put on his hat and sunglasses one afternoon last fall, Youssouf was still a workingman with neither a work permit nor the Spanish residency documentation that would allow him to cross more national borders legally. *"Tirando maletas,"* he said: heaving suitcases around. That was the migrant life he found.

But look, he said, striding easily now toward the center of town: He is sleeping under a solid roof. Work in the orchards and berry fields is hard and sporadic, but every month he sends home at least a hundred euros through one of the money transfer services proliferating around Lepe. His son and daughter are doing well in school. They have enough to eat. Youssouf bought a Huawei tablet, and when he finds

THE LURE OF SPAIN

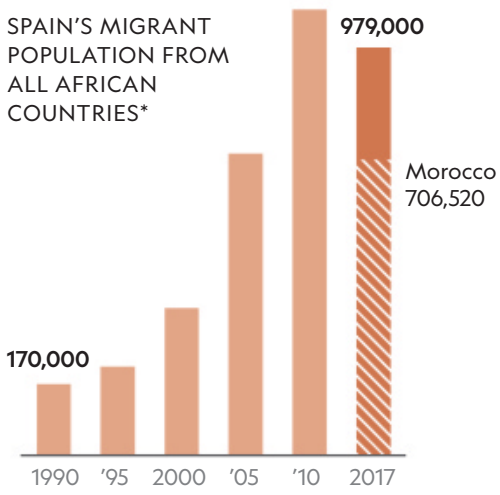
Waves of African migrants have come to Spain in recent decades, most of them enticed by Spanish demand for foreign labor, some by the need to escape instability or conflict. Nearly a million Africans now call Spain home.

AFRICAN COUNTRIES WITH THE LARGEST MIGRANT POPULATIONS LIVING IN SPAIN (2017)



Spain has a bilateral migration agreement with Morocco for Spanish employers to recruit Moroccan agricultural workers.

SPAIN'S MIGRANT POPULATION FROM ALL AFRICAN COUNTRIES*



African migrants living in Spain in 2017 originated from almost every country on the continent. Ninety-five percent were from 10 African nations, including Morocco—which accounted for roughly three-quarters of the total.

*INCLUDES REFUGEES AND ASYLUM SEEKERS

RYAN MORRIS AND KAYA BERNE, NGM STAFF

SOURCES: UNITED NATIONS, DEPARTMENT OF ECONOMIC AND SOCIAL AFFAIRS, POPULATION DIVISION; UNITED NATIONS HIGH COMMISSIONER FOR REFUGEES

SEEKING REFUGE

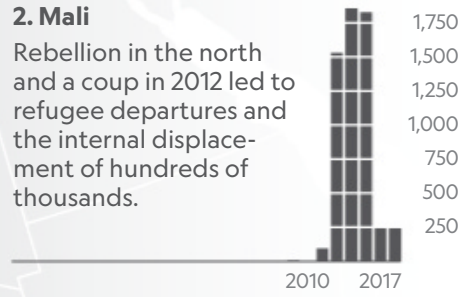
LEADING COUNTRIES OF ORIGIN FOR AFRICAN REFUGEES AND ASYLUM SEEKERS IN SPAIN (1991–2017)

1. Algeria

A 1992 military coup and 10-year civil war between the Algerian government and Islamist groups sent thousands fleeing to Spain.

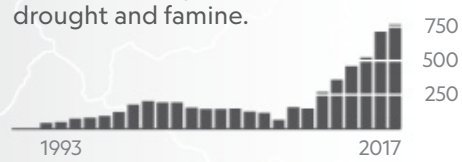
2. Mali

Rebellion in the north and a coup in 2012 led to refugee departures and the internal displacement of hundreds of thousands.



3. Somalia

Thousands have fled Somalia due to ongoing armed conflict since 1991, as well as periods of severe drought and famine.



4. Equatorial Guinea

Decades of authoritarian rule drove political dissidents and others to Spain, the country's former colonial power.

5. Côte d'Ivoire (Ivory Coast)

Civil war began in 2002; in 2010 a contested presidential election further divided the country between north and south.

6. Democratic Republic of the Congo

War overwhelmed the resource-rich Democratic Republic of the Congo beginning in 1996.

free Wi-Fi, he can download Malian music and talk with his family by video. In Bamako he was able to touch his wife and children and live with them, but what he could not do for them, with a Malian laborer's wages and their small plot of inherited land, was more than he could bear. "It's still better that I'm here," he said.

Youssouf could give up on Europe, yes. He could save for a one-way ticket home. But he won't, not yet. Too much has been invested in him—the payments to the smugglers, the expectations layered thick from so many years away. He's too embarrassed to go back. "Not with empty hands," he said.

Rounding a corner, a block from the Lepe plaza where migrants from many nations gather at dusk, Youssouf raised an arm in greeting. The younger man he hailed was a Malian named Ibrahim, and in Bambara he replied according to protocol: Yes, his extended family was well, his close family was well, he was well. Except that he wasn't. He was just back in Lepe, after a harvest job in another province, and had spent the night in a cardboard box on the street.

Youssouf and Ibrahim looked at each other. "No, I don't tell my family much," Ibrahim said. "I send money to my brother. He shares it with everyone. I haven't seen them in almost 10 years."

They considered, standing on the street together, what might make them feel they could return to Mali with dignity.

"Enough money to buy a good house," Ibrahim said.

"Enough money to start a business," Youssouf said. "In agriculture I've learned a lot."

Ibrahim said he needed to find an indoor bed for the night. Youssouf told him to stop by the migrant shelter. There's Wi-Fi inside the building too, and later that evening Youssouf used his tablet to send off his most recent collection of Lepe photos. He'd found an app to make them special for his family. Click on an arrow, piano music plays, and images appear in rotation: Youssouf on a beach, Youssouf in a park, Youssouf beside a car. In the last few pictures he's in an office chair, wearing a button-down shirt with a pen in the breast pocket, sunglasses pushed atop his head. His legs are spread. He's smiling into the camera. He looks great. ▯

Cynthia Gorney wrote about migrant workers in the United Arab Emirates in the January 2014 issue of *National Geographic*. Spanish photographer **Aitor Lara** is a first-time contributor.

In the 1980s, as irrigation and greenhouses were transforming the southern Spanish region of Andalusia, Francisco Braima Sanhá arrived from Guinea-Bissau as a cook. Now 59, a veteran among foreign laborers, he checks the vegetable garden he planted around his shack. The modern Andalusian agricultural economy has exploded, Braima says—"thanks to the migrants."

Fabric and a few props are enough for photographer Alexia Webster to make portrait studios on sidewalks and near cafés. In Tijuana, Mexico, she photographed migrants and Mexicans such as Gerardo Herrera Betancourt (left), from Mexico City, who come to Tijuana seeking work.

IN TIJUANA, NEAR THE WORLD'S BUSIEST LAND BORDER CROSSING, A PHOTOGRAPHER MAKES MEMORIES FOR MIGRANTS AND OTHERS PASSING BY.

BY **NINA STROCHLIC** PHOTOGRAPHS BY **ALEXIA WEBSTER**

PORTRAITS FROM A BUSTLING BORDER

PORTRAITS FROM A BUSTLING BORDER

A WORLD ON THE MOVE

THE SET IS SIMPLE: a little fabric, a chair, maybe some flowers. Its inhabitants are more complex: an American mother who takes her children to visit their Mexican father every weekend. A recent deportee trying to rebuild his life. They pause what they're doing, sit for a portrait, and leave with a printed copy. Behind the camera is Alexia Webster, a South African photographer who sets up street studios around the world. At Studio Transfronterizo, her project in Tijuana, Mexico, passing characters offer a glimpse of life on the world's busiest land border. ¶ Every day nearly 100,000 people—commuters, students, visitors—legally cross from Tijuana to San Diego, California, at the San Ysidro border. Webster built her first studio in Tijuana near a café where new arrivals often stop for legal advice and a free lunch. She set up a half dozen more in the city: at a migrant shelter, on the beach where the border fence ends, in the Undocumented Café near the binational Friendship Park. ¶ Passersby who asked what she was doing often sat for a portrait. Lourdes Santiago González posed with her daughter, Brenda. She'd arrived decades earlier with her family to cross the border but after multiple failed attempts had stayed in Tijuana. At each set, lines of people waited: a former gang member deported from California. A celebrity impersonator performing on the nightclub circuit. Migrants from Honduras and El Salvador en route to the United States.

Nine-year-old Jaime Preciado nudged his dad onto the set. He wanted to "have a memory of us together" before his father went back to California.

More than a decade ago Webster was photographing for the United Nations in a refugee camp in Kenya when a man told her he'd watched photographers visit for 15 years but didn't have a single picture of himself or his family. Webster thought of a studio shot of her grandparents with her mom as a child soon after they emigrated from Greece to South Africa. "It's the most precious photograph I own," she says. "It's a connection to who I am." Many of Webster's subjects had fled war, leaving personal archives behind. One photo could help them rebuild.

In 2011, with a printer and a temporary portrait studio on a corner in Cape Town, Webster invited people to pose for a free session. She printed their picture on the spot. "Primarily it's for them, for their kids, their grandkids, their lovers, their friends," she says. "It's a record of who they are." Webster has since put up studios in other places, from the streets of Mumbai, India, to a refugee camp in South Sudan.

She gives few instructions from behind the camera. "The idea of the project is for people to rebuild their archive and reaffirm their identity," Webster says. "I like for them to determine how they want their photo to be. How do you want to be represented?" ▯

NGM MAPS

In 2018 caravans of migrants from Central America began walking toward the U.S. border. Besy Samileth, a 17-year-old from Honduras, traveled with her father to pursue a dream of becoming a teacher.

After this photo was taken, Salvadoran migrants Blanca Flores and her husband, José Israel Mejía (right), were granted asylum in the U.S. Mejía's 16-year-old brother, Jaime (left), was detained and deported.

Juana Sorto also came to Tijuana to apply for asylum at the border. She left behind nine children in Honduras with the hope of getting medical treatment for her son, Nedi Salomón.

Migrants and Tijuana residents come from a variety of backgrounds. Clockwise from top left: Samanta and José Vieyra; Michelet Duprevir; Pedro Alberto Córdoba; and Jesús González Tejada and Rhonda Moore.

THIS STORY WAS SUPPORTED BY THE INTERNATIONAL WOMEN'S MEDIA FOUNDATION.

Webster hopes her street studio series allows migrants like Guillermo Antonio Escobar, a construction worker from El Salvador, to rebuild the photo archives they may have lost during difficult times.

Three waves of immigrants settled prehistoric Europe. The last, some 5,000 years ago, were the Yamnaya, horse-riding cattle herders from Russia who built imposing grave mounds like this one near Žabalj, Serbia.

DANUBIAN ROUTE OF YAMNAYA CULTURE PROJECT, NATIONAL SCIENCE CENTER, POLAND

Yamnaya artifacts from their homeland in Russia and Ukraine include (1) a model, found in a 2500 B.C. grave, of a wheeled wagon like those they used to travel across the steppes; (2) a bronze knife blade; (3) a necklace made of fish teeth; (4) sheep ankle bones used for games; (5) a human skull painted with ocher, a natural clay pigment; and (6) a four-foot-tall anthropomorphic stela from 3000 B.C. featuring axes and horses.

STATE HISTORICAL MUSEUM, MOSCOW (1-5); DNIPROPETROVSK NATIONAL HISTORICAL MUSEUM

WHO WERE THE FIRST EUROPEANS?

NEW GENETIC TESTING OF ANCIENT SETTLERS' REMAINS IS REVEALING THAT EUROPE HAS LONG BEEN A MELTING POT, MADE UP OF IMMIGRANT BLOODLINES FROM AFRICA, THE MIDDLE EAST, AND THE GRASSY PLAINS OF TODAY'S RUSSIA.

BY **ANDREW CURRY**
PHOTOGRAPHS BY **RÉMI BÉNALI**

WHO WERE THE FIRST

The horsemanship the Yamnaya brought to Europe lives on in their native region. A rider at the Zaporizhzhya Cossack Museum on Ukraine's Khortytsya Island demonstrates the acrobatic skills that made the Cossacks such feared warriors from the 1400s on.

A WORLD ON THE MOVE

THE IDEA THAT THERE WERE ONCE "pure" populations of ancestral Europeans, there since the days of woolly mammoths, has inspired ideologues since well before the Nazis. It has long nourished white racism, and in recent years it has stoked fears about the impact of immigrants: fears that have threatened to rip apart the European Union and roiled politics in the United States. ¶ Now scientists are delivering new answers to the question of who Europeans really are and where they came from. Their findings suggest that the continent has been a melting pot since the Ice Age. Europeans living today, in whatever country, are a varying mix of ancient bloodlines hailing from Africa, the Middle East, and the Russian steppe. ¶ The evidence comes from archaeological artifacts, from the analysis of ancient teeth and bones, and from linguistics. But above all it comes from the new field of paleogenetics. During the past decade it has become possible to sequence the entire genome of humans who lived tens of millennia ago. Technical advances in just the past few years have made it cheap and efficient to do so; a well-preserved bit of skeleton can now be sequenced for around $500.

The result has been an explosion of new information that is transforming archaeology. In 2018 alone, the genomes of more than a thousand prehistoric humans were determined, mostly from bones dug up years ago and preserved in museums and archaeological labs. In the process any notion of European genetic purity has been swept away on a tide of powdered bone.

Analysis of ancient genomes provides the equivalent of the personal DNA testing kits available today, but for people who died long before humans invented writing, the wheel, or pottery. The genetic information is startlingly complete: Everything from hair and eye color to the inability to digest milk can be determined from a thousandth of an ounce of bone or tooth. And like personal DNA tests, the results reveal clues to the identities and origins of ancient humans' ancestors—and thus to ancient migrations.

Three major movements of people, it now seems clear, shaped the course of European prehistory. Immigrants brought art and music, farming and cities, domesticated horses and the wheel. They introduced the Indo-European languages spoken across much of the continent today. They may have even brought the plague. The last major contributors to western and central Europe's genetic makeup—the last of the first Europeans, so to speak—arrived from the Russian steppe as Stonehenge was being built, nearly 5,000 years ago. They finished the job.

In an era of debate over migration and borders, the science shows that Europe is a continent of immigrants and always has been. "The people who live in a place today are not the descendants of people who lived there long ago," says Harvard

DNA recovered from ancient teeth and bones lets researchers understand population shifts over time. As the cost of sequencing DNA has plummeted, scientists at labs like this one in Jena, Germany, have been able to unravel patterns of past human migration.

MAX PLANCK INSTITUTE FOR THE SCIENCE OF HUMAN HISTORY

In Sweden, ancient rock carvings (enhanced with modern red paint) echo cultural shifts brought by migrants—starting with hunter-gatherers who came from Africa in the Ice Age and followed retreating glaciers north. Their DNA is still prevalent, especially in southern Baltic countries.

TANUM WORLD HERITAGE

University paleogeneticist David Reich. "There are no indigenous people—anyone who harkens back to racial purity is confronted with the meaninglessness of the concept."

FIRST WAVE

OUT OF AFRICA

THIRTY-TWO YEARS AGO the study of the DNA of living humans helped establish that we all share a family tree and a primordial migration story: All people outside Africa are descended from ancestors who left that continent more than 60,000 years ago. About 45,000 years ago, those first modern humans ventured into Europe, having made their way up through the Middle East. Their own DNA suggests they had dark skin and perhaps light eyes.

Europe then was a forbidding place. Mile-thick ice sheets covered parts of the continent. Where there was enough warmth, there was wildlife. There were also other humans, but not like us: Neanderthals, whose own ancestors had wandered out of Africa hundreds of thousands of years earlier, had already adapted to the cold and harsh conditions.

The first modern Europeans lived as hunters and gatherers in small, nomadic bands. They followed the rivers, edging along the Danube from its mouth on the Black Sea deep into western and central Europe. For millennia, they made little impact. Their DNA indicates they mixed with the Neanderthals—who, within 5,000 years, were gone. Today about 2 percent of a typical European's genome consists of Neanderthal DNA. A typical African has none.

As Europe was gripped by the Ice Age, the modern humans hung on in the ice-free south, adapting to the cold climate. Around 27,000 years ago, there may have been as few as a thousand of them, according to some population estimates. They subsisted on large mammals such as mammoths, horses, reindeer, and aurochs—the ancestors of modern cattle. In the caves where they sheltered, they left behind spectacular paintings and engravings of their prey.

About 14,500 years ago, as Europe began to warm, humans followed the retreating glaciers north. In the ensuing millennia, they developed more sophisticated stone tools and settled in small villages. Archaeologists call this period the Mesolithic, or Middle Stone Age.

In the 1960s Serbian archaeologists uncovered a Mesolithic fishing village nestled in steep cliffs on a bend of the Danube, near one of the river's narrowest points. Called Lepenski Vir, the site was an elaborate settlement that had housed as many as a hundred people, starting roughly 9,000 years ago. Some dwellings were furnished with carved sculptures that were half human, half fish.

Bones found at Lepenski Vir indicated that the people there depended heavily on fish from the river. Today what remains of the village is preserved under a canopy overlooking the Danube; sculptures of goggle-eyed river gods still watch over ancient hearths. "Seventy percent of their diet was fish," says Vladimir Nojkovic, the site's director. "They lived here almost 2,000 years, until farmers pushed them out."

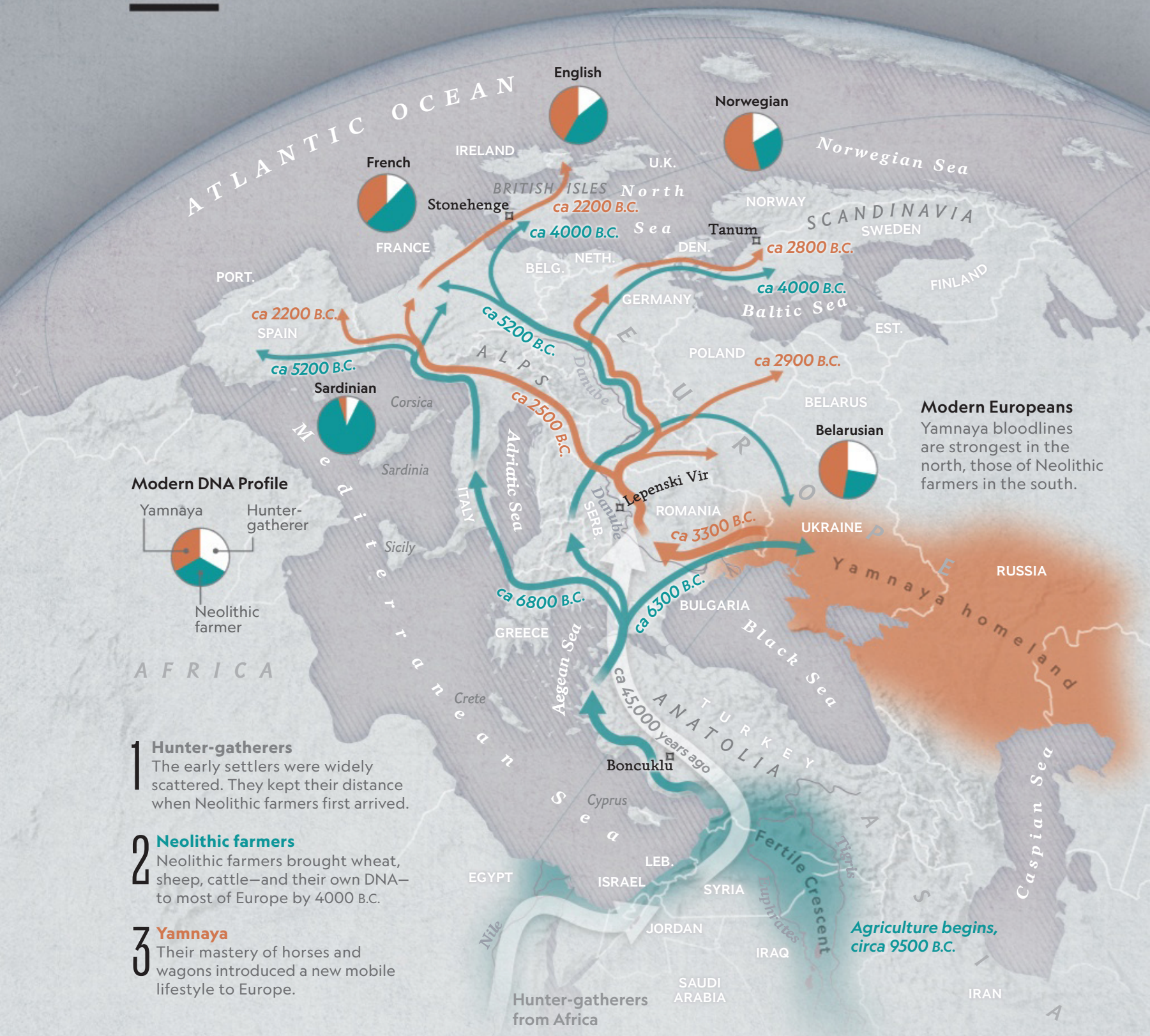
SECOND WAVE

OUT OF ANATOLIA

THE KONYA PLAIN in central Anatolia is modern Turkey's breadbasket, a fertile expanse where you can see rainstorms blotting out mountains on the horizon long before they begin spattering the dust around you. It has been home to farmers, says University of Liverpool archaeologist Douglas Baird, since the first days of farming. For more than a decade Baird has been excavating a prehistoric village here called Boncuklu. It's a place where people began planting small plots of emmer and einkorn, two ancient forms

PREHISTORIC MELTING POT

Hunter-gatherers, modern humans whose ancestors evolved in Africa, reached Europe some 45,000 years ago. By 6000 B.C. Neolithic farmers from present-day Turkey had joined them in southern Europe before pushing deeper into the continent. The Yamnaya then swept in from Russia. Most Europeans today have DNA from all three groups.



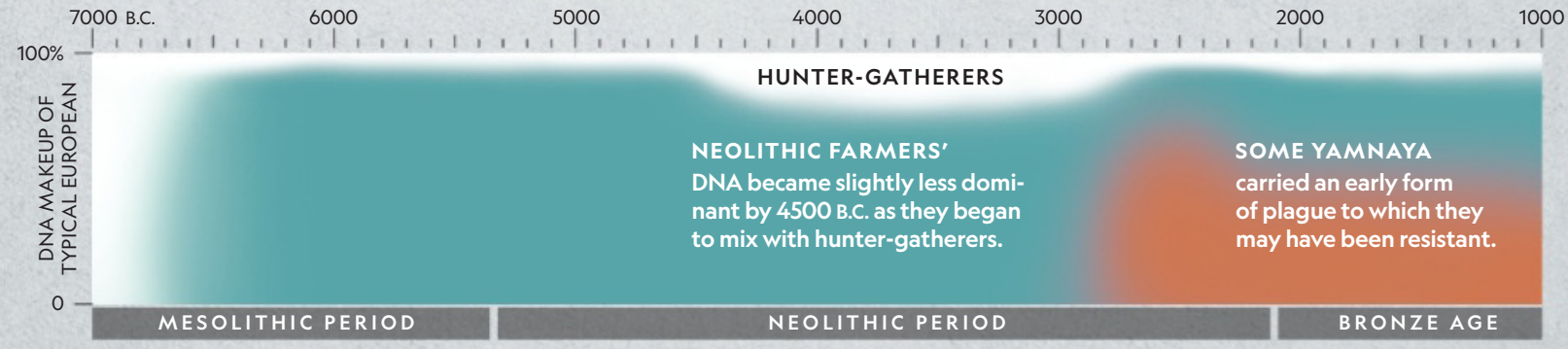
1 Hunter-gatherers
The early settlers were widely scattered. They kept their distance when Neolithic farmers first arrived.

2 Neolithic farmers
Neolithic farmers brought wheat, sheep, cattle—and their own DNA—to most of Europe by 4000 B.C.

3 Yamnaya
Their mastery of horses and wagons introduced a new mobile lifestyle to Europe.

DNA LEGACY

Before the arrival of the Yamnaya, Neolithic farmer DNA had largely replaced that of hunter-gatherers. By 1000 B.C. Yamnaya DNA could be found all across Europe.



MAP SHOWS MODERN COASTLINES AND DRAINAGE. SCALE VARIES IN THIS PERSPECTIVE.
MATTHEW W. CHWASTYK AND MANUEL CANALES, NGM STAFF; SHELLEY SPERRY. SOURCES: IOSIF LAZARIDIS, IÑIGO OLALDE, AND DAVID REICH, HARVARD MEDICAL SCHOOL; DAVID ANTHONY, HARTWICK COLLEGE; WOLFGANG HAAK AND OTHERS, *NATURE*, 2015

A woman harvests wheat by hand near Konya, Turkey. Farmers from Anatolia brought agriculture to Europe starting nearly 9,000 years ago. Within a few millennia, farmers and herders dominated most of the continent.

of wheat, and probably herding small flocks of sheep and goats, some 10,300 years ago, near the dawn of the Neolithic period.

Within a thousand years the Neolithic revolution, as it's called, spread north through Anatolia and into southeastern Europe. By about 6,000 years ago, there were farmers and herders all across Europe.

It has long been clear that Europe acquired the practice of farming from Turkey or the Levant, but did it acquire farmers from the same places? The answer isn't obvious. For decades, many archaeologists thought a whole suite of innovations—farming, but also ceramic pottery, polished stone axes capable of clearing forests, and complicated settlements—was carried into Europe not by migrants but by trade and word of mouth, from one valley to the next, as hunter-gatherers who already lived there adopted the new tools and way of life.

But DNA evidence from Boncuklu has helped show that migration had a lot more to do with it. The farmers of Boncuklu kept their dead close, burying them in the fetal position under the floors of their houses. Beginning in 2014, Baird sent samples of DNA extracted from skull fragments and teeth from more than a dozen burials to DNA labs in Sweden, Turkey, the U.K., and Germany.

Many of the samples were too badly degraded after spending millennia in the heat of the Konya Plain to yield much DNA. But then Johannes Krause and his team at Germany's Max Planck Institute for the Science of Human History tested the samples from a handful of petrous bones. The petrous bone is a tiny part of the inner ear, not much bigger than a pinkie tip; it's also about the densest bone in the body. Researchers have found that it preserves genetic information long after usable DNA has been baked out of the rest

of a skeleton. That realization, along with better sequencing machines, has helped drive the explosion in ancient DNA studies.

The Boncuklu petrous bones paid off: DNA extracted from them was a match for farmers who lived and died centuries later and hundreds of miles to the northwest. That meant early Anatolian farmers had migrated, spreading their genes as well as their lifestyle.

They didn't stop in southeastern Europe. Over the centuries their descendants pushed along the Danube past Lepenski Vir and deep into the heart of the continent. Others traveled along the Mediterranean by boat, colonizing islands such as Sardinia and Sicily and settling southern Europe as far as Portugal. From Boncuklu to Britain, the Anatolian genetic signature is found wherever farming first appears.

Those Neolithic farmers mostly had light skin and dark eyes—the opposite of many of the hunter-gatherers with whom they now lived side by side. "They looked different, spoke different languages … had different diets," says Hartwick College archaeologist David Anthony. "For the most part, they stayed separate."

Across Europe, this creeping first contact was standoffish, sometimes for centuries. There's little evidence of one group taking up the tools or traditions of the other. Even where the two populations did mingle, intermarriage was rare. "There's no question they were in contact with each other, but they weren't exchanging wives or husbands," Anthony says. "Defying every anthropology course, people were not having sex with each other." Fear of the other has a long history.

ABOUT 5,400 YEARS AGO, everything changed. All across Europe, thriving Neolithic settlements shrank or disappeared altogether. The dramatic decline has puzzled archaeologists for decades. "There's less stuff, less material, less people, less sites," Krause says. "Without some major event, it's hard to explain." But there's no sign of mass conflict or war.

After a 500-year gap, the population seemed to grow again, but something was very different. In southeastern Europe, the villages and egalitarian cemeteries of the Neolithic were replaced by imposing grave mounds covering lone adult men. Farther north, from Russia to the Rhine, a new culture sprang up, called Corded Ware after its pottery, which was decorated by pressing string into wet clay.

The State Museum of Prehistory in Halle, Germany, has dozens of Corded Ware graves, including many that were hastily rescued by archaeologists before construction crews went to work. To save time and preserve delicate remains, the graves were removed from the ground in wooden crates, soil and all, and stored in a warehouse for later analysis. Stacked to the ceiling on steel shelves, they're now a rich resource for geneticists.

Corded Ware burials are so recognizable, archaeologists rarely need to bother with radiocarbon dating. Almost invariably, men were buried lying on their right side and women lying on their left, both with their legs curled up and their faces pointed south. In some of the Halle warehouse's graves, women clutch purses and bags hung with canine teeth from dozens of dogs; men have stone battle-axes. In one grave,

neatly contained in a wooden crate on the concrete floor of the warehouse, a woman and child are buried together.

When researchers first analyzed the DNA from some of these graves, they expected the Corded Ware folk would be closely related to Neolithic farmers. Instead, their DNA contained distinctive genes that were new to Europe at the time—but are detectable now in just about every modern European population. Many Corded Ware people turned out to be more closely related to Native Americans than to Neolithic European farmers. That deepened the mystery of who they were.

THIRD WAVE

OUT OF THE STEPPE

ONE BRIGHT OCTOBER MORNING near the Serbian town of Žabalj, Polish archaeologist Piotr Włodarczak and his colleagues steer their pickup toward a mound erected 4,700 years ago. On the plains flanking the Danube, mounds like this one, a hundred feet across and 10 feet high, provide the only topography. It would have taken weeks or months for prehistoric humans to build each one. It took Włodarczak's team weeks of digging with a backhoe and shovels to remove the top of the mound.

Standing on it now, he peels back a tarp to reveal what's underneath: a rectangular chamber containing the skeleton of a chieftain, lying on his back with his knees bent. Impressions from the reed mats and wood beams that formed the roof of his tomb are still clear in the dark, hard-packed earth.

"It's a change of burial customs around 2800 B.C.," Włodarczak says, crouching over the skeleton. "People erected mounds on a massive scale, accenting the individuality of people, accenting the role of men, accenting weapons. That's something new in Europe."

It was not new 800 miles to the east, however. On what are now the steppes of southern Russia and eastern Ukraine, a group of nomads called the Yamnaya, some of the first people in the world to ride horses, had mastered the wheel and were building wagons and following herds of cattle across the grasslands. They built few permanent settlements. But they buried their most prominent men with bronze and silver ornaments in mighty grave mounds that still dot the steppes.

By 2800 B.C., archaeological excavations show, the Yamnaya had begun moving west, probably looking for greener pastures. Włodarczak's mound near Žabalj is the westernmost Yamnaya grave found so far. But genetic evidence, Reich and others say, shows that many Corded Ware people were, to a large extent, their descendants. Like those Corded Ware skeletons, the Yamnaya shared distant kinship with Native Americans—whose ancestors hailed from farther east, in Siberia.

Within a few centuries, other people with a significant amount of Yamnaya DNA had spread as far as the British Isles. In Britain and some other places, hardly any of the farmers who already lived in Europe survived the onslaught from the east. In what is now Germany, "there's a 70 percent to possibly 100 percent replacement of the local population," Reich says. "Something very dramatic happens 4,500 years ago."

Until then, farmers had been thriving in Europe for millennia. They had settled from Bulgaria all the way to Ireland, often in complex villages that housed hundreds or even thousands of people. Volker Heyd, an archaeologist at the University of Helsinki, Finland, estimates there were as many as seven million people in Europe in 3000 B.C. In Britain, Neolithic people were constructing Stonehenge.

To many archaeologists, the idea that a bunch of nomads could replace such an established civilization within a few centuries has seemed implausible. "How the hell would these pastoral, decentralized groups overthrow grounded Neolithic society, even if they had horses and were good warriors?" asks Kristian Kristiansen, an archaeologist at the University of Gothenburg in Sweden.

A clue comes from the teeth of 101 people living on the steppes and farther west in Europe around the time that the Yamnaya's westward migration began. In seven of the samples,

1

2

3

Artifacts some 7,700 years old found at Aktopraklik, a Neolithic village in northwestern Turkey, offer clues to the early days of agriculture. A ceramic sherd bearing an image of wheat (1) and a grindstone (2) testify to grain farming. A terra-cotta statuette of a woman (3) may symbolize fertility. DNA extracted from the skulls (4) of people buried here has helped researchers trace the spread of early farmers into Europe.

BURSA CITY MUSEUM, TURKEY

4

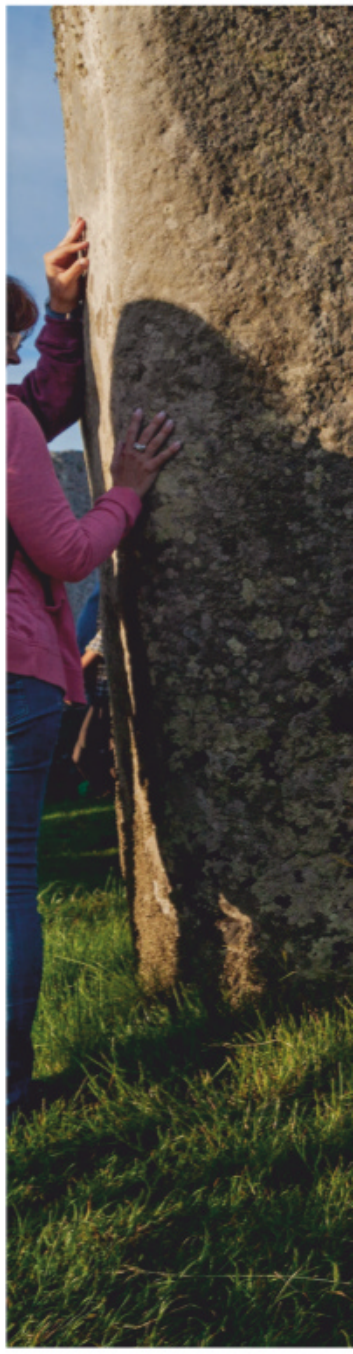
Masked figures at the annual carnival in Ottana, a village on the Italian island of Sardinia, act out human mastery over animals, a theme dating to the early days of domestication. DNA of Europe's first farmers still dominates the genes of modern Sardinians.

alongside the human DNA, geneticists found the DNA of an early form of *Yersinia pestis*—the plague microbe that killed roughly half of all Europeans in the 14th century.

Unlike that flea-borne Black Death, this early variant had to be passed from person to person. The steppe nomads apparently had lived with the disease for centuries, perhaps building up immunity or resistance—much as the Europeans who colonized the Americas carried smallpox without succumbing to it wholesale. And just as smallpox and other diseases ravaged Native American populations, the plague, once introduced by the first Yamnaya, might have spread rapidly through crowded Neolithic villages. That could explain both their surprising collapse and the rapid spread of Yamnaya DNA from Russia to Britain.

"Plague epidemics cleared the way for the Yamnaya expansion," says Morten Allentoft, an evolutionary biologist at the Natural History Museum of Denmark, who helped identify the ancient plague DNA.

But that theory has a major question: Evidence of plague has only just recently been documented in ancient Neolithic skeletons, and so far, no one has found anything like the plague pits full of diseased skeletons left behind after the Black Death. If a plague wiped out Europe's Neolithic farmers, it left little trace.



When construction of Stonehenge began about 3000 B.C., Britain was inhabited by Neolithic farmers. A millennium later, when it was finished, the Neolithic population had been replaced by descendants of the Yamnaya—perhaps because the latter carried plague.

WHETHER OR NOT they brought plague, the Yamnaya did bring domesticated horses and a mobile lifestyle based on wagons into Stone Age Europe. And in bringing innovative metal weapons and tools, they may have helped nudge Europe toward the Bronze Age.

That might not have been the Yamnaya's most significant contribution to Europe's development. Their arrival on the continent matches the time linguists pinpoint as the initial spread of Indo-European languages, a family of hundreds that includes most languages spoken from Ireland to Russia to the northern half of India. All are thought to have evolved from a single proto-Indo-European tongue, and the question of where it was spoken and by whom has been debated since the 19th century. According to one theory, it was the Neolithic farmers from Anatolia who brought it into Europe along with farming.

Another theory, proposed a century ago by a German scholar named Gustaf Kossinna, held that the proto-Indo-Europeans were an ancient race of north Germans—the people who made Corded Ware pots and axes. Kossinna thought that the ethnicity of people in the past—their biological identity, in effect—could be deduced from the stuff they left behind.

"Sharply defined archaeological cultural areas," he wrote, "correspond unquestionably with the areas of particular people or tribes."

The north German tribe of proto-Indo-Europeans, Kossinna argued, had moved outward and dominated an area that stretched most of the way to Moscow. Nazi propagandists later used that as an intellectual justification for the modern Aryan "master race" to invade eastern Europe.

Partly as a result, for decades after World War II the whole idea that ancient cultural shifts might be explained by migrations fell into ill repute in some archaeological circles. Even today it makes some archaeologists

uncomfortable when geneticists draw bold arrows across maps of Europe.

"This kind of simplicity leads back to Kossinna," says Heyd, who's German. "It calls back old demons of blond, blue-eyed guys coming back somehow out of the hell where they were sent after World War II."

Yet ancient DNA, which provides direct information about the biology of ancient humans, has become a strong argument against Kossinna's theory. First, in documenting the spread of the Yamnaya and their descendants deeper and deeper into Europe at just the right time, the DNA evidence supports the favored theory among linguists: that proto-Indo-Europeans migrated into Europe from the Russian steppe, not the other way around. Second, together with archaeology it amounts to a rejection of Kossinna's claim that some kind of pure race exists in Europe, one that can be identified from its cultural artifacts.

All Europeans today are a mix. The genetic recipe for a typical European would be roughly equal parts Yamnaya and Anatolian farmer, with a much smaller dollop of African hunter-gatherer. But the average conceals large regional variations: more "eastern cowboy" genes in Scandinavia, more farmer ones in Spain and Italy, and significant chunks of hunter-gatherer DNA in the Baltics and eastern Europe.

"To me, the new results from DNA are undermining the nationalist paradigm that we have always lived here and not mixed with other people," Gothenburg's Kristiansen says. "There's no such thing as a Dane or a Swede or a German." Instead, "we're all Russians, all Africans." □

From his base in Berlin, **Andrew Curry** writes about archaeology and other subjects. **Rémi Bénali** lives near Arles, France, where he photographed a Roman boat for the April 2014 issue.

All senses on alert, a wolverine in Montana's Swan Valley triggers a camera trap while feeding on a deer carcass. These secretive predators are built for survival in frozen northern landscapes. Can they adapt to a warming world?

WITH ASSISTANCE FROM SWAN VALLEY CONNECTIONS

BY **DOUGLAS H. CHADWICK**

PHOTOGRAPHS BY **STEVEN GNAM**

THE SURVIVORS

WOLVERINES, THE SMALL AND FIERCE CARNIVORES OF THE FAR NORTH, ARE BATTLING NEW THREATS AS WARMING SHRINKS THEIR TERRITORY.

One night years ago, biologist Albert Manville drove to a garbage dump near Lake Louise in Alberta's Banff National Park.

THE SITE WAS UNFENCED back then, and grizzlies often came to rummage for leftovers. Manville was watching a bear feast on a hefty scrap of meat when he noticed movement toward the edge of his car's beaming headlights. It was a wolverine, staring intently at the bear and the meat. What else could it do? It weighed maybe 30 pounds; the grizzly weighed several hundred.

"Then all at once the wolverine ran up and bit the bear right on the butt," Manville says. "The grizzly whirled and swiped with a paw, but the wolverine was already racing around to one side. It grabbed the meat and ran off into the dark."

A wolverine doesn't seem like a reasonable beast, for it acts too tough and brazen for its size. But at barely three feet long from keen nose to bushy tail, an average wolverine will claim a territory of 100 to more than 500 square miles, then patrol it at an unrelenting pace, sniffing, probing, hunting, scavenging, and defending its home from rivals.

In the five years that I volunteered with a groundbreaking study in Montana's Glacier National Park, I tracked one radio-tagged male as he climbed 1,500 feet straight up an ice-packed chute on a sheer mountainside and crossed the Continental Divide. The ascent took him less than 20 minutes.

Another male scaled the park's highest summit—10,466-foot-high Mount Cleveland—in January, when the peak was a towering ice sculpture. He covered the last 4,900 feet in 90 minutes. Within the next 10 days he climbed other crests to the west, turned north into British Columbia, loped east across the divide and on through Waterton Lakes National Park in Alberta, and returned south across more massifs to get back to Glacier. No big deal. Within a day or two he took off and made the journey all over again.

SKUNK BEAR. MOUNTAIN DEVIL. Demon of the North. For centuries wolverines were defined not only as greedy, god-awful smelling, and eerily wily and elusive but also as foul-tempered, wantonly destructive, and a danger to people in the backcountry. But none of these characterizations fit.

Gulo gulo (from the Latin word for "glutton") is native to Arctic, subarctic, and mountain regions of the Northern Hemisphere. The species is part of the large and varied mustelid family, many of which have revved-up metabolisms. The group includes martens, weasels, badgers, honey badgers, otters, and sea otters. Of the group's nonaquatic members, the wolverine has the heaviest skull, thickest jaws, biggest teeth, largest body, and largest feet. A single gulo can bring down prey as large as an adult caribou, and unverified reports describe wolverines occasionally forcing wolves and even big bears away from a carcass.

The last thing a wolverine is, so it would seem, is vulnerable. But trappers, hunters, and livestock owners erased the animal from much of Eurasia. In the New World, government-sponsored predator eradication campaigns took a heavy toll. By the 1930s the species had disappeared from the lower 48 states.

Yet wolverines are tenacious survivors that still have strongholds in Alaska and parts of

A trail of tracks reflects the mostly unseen presence of wolverines in Glacier National Park. Erased from the lower 48 states by the 1930s, wolverines from Canada have recolonized mountainous portions of Montana, Idaho, Wyoming, and Washington State.

Wolverines aren't as choosy about what they eat as they are about where they live. Rodents, birds, and larger mammals are favorite prey, but in winter they rely on carrion, such as this deer leg (top). In their relentless hunt for food, wolverines routinely range over hundreds of square miles of rugged terrain. Large paws with sharp, curved claws (above) enable these dauntless explorers to scale sheer ice faces in minutes (right). Around late February, females burrow deep into snowpacks to create dens, where they give birth to one to three kits. Rising temperatures and reduced spring snow cover could further shrink their habitat.

WITH ASSISTANCE FROM SWAN VALLEY CONNECTIONS (TOP)

REALM OF THE WOLVERINE

Trapping and human settlement have shrunk wolverines' historic range. Dependent on vast home territories, they are scarce even in remote northern forests and tundra regions, their primary habitat.

western Canada. As predator poisoning was phased out during the 1960s, wolverines from the Canadian Rockies started to recolonize Montana's high country and spread to parts of Idaho and northern Wyoming.

Then, in the 1990s, wolverines from Canada began venturing into Washington's northern Cascades. Today breeding groups live in four states: Montana, Idaho, Wyoming, and Washington, but the population remains small. A recent estimate put the number of wolverines south of Canada at around 300 animals.

Meanwhile, populations on both sides of the U.S.-Canada border face a variety of threats. Most come from expanding human activities in the backcountry, but one concern overrides all others: a warming climate. *Gulo gulo* is specially adapted to, and highly dependent on, habitats with year-round cool conditions and lingering snowpack. Although polar regions are heating up faster than other latitudes, similar temperature increases are happening in the planet's high altitudes, such as the Rockies. If climate change continues as predicted, wolverines could lose one-third of their present range south of Canada by 2050, and two-thirds before the end of this century.

Since 1994, despite petitions and lawsuits

A wolverine in northern Montana is one of only about 300 living in the contiguous U.S. Climate change threatens to isolate the vulnerable population, but efforts to protect it under the Endangered Species Act have stalled.

JOHN KAPPLER, NGM STAFF. SOURCES: KEITH AUBRY, U.S. FOREST SERVICE; ALASKA DEPARTMENT OF FISH AND GAME; ENVIRONMENT CANADA, *SPECIES AT RISK ACT: RECOVERY STRATEGY SERIES,* 2016; BRIAN G. SLOUGH, *WILDLIFE BIOLOGY,* 2007

seeking to protect wolverines under the Endangered Species Act, the U.S. Fish and Wildlife Service has resisted listing wolverines as threatened. In 2016, citing the growing threat of climate change, a federal judge ordered the agency to reconsider its decision. That's where the matter stands today: in limbo.

Glacier National Park is home to the densest populations of wolverines in the contiguous U.S. But because each wolverine jealously guards a huge territory, a total of 30 to 40 is about all that will ever fit into the 1,500-square-mile park. Fact is, no single preserve holds a wolverine population large enough to be truly self-sustaining. To cope with environmental changes and avoid inbreeding over the long run, every group needs to be connected to others within a larger region.

Biologists used to say that the best plan to conserve wildlife is to set aside parks and preserves. Now they say we must also safeguard natural corridors that link protected areas, ensuring that species such as wolverines can travel across large landscapes, exchange genes, and adjust to shifting conditions. Wolverines aren't much for theory, but they know instinctively not to do things halfway. You have to go the distance. ▯

Wildlife biologist and writer **Douglas H. Chadwick** is author of *The Wolverine Way*. Photographer **Steven Gnam** specializes in exploring and illuminating our connection to nature.

LONDON

AMID GROWING PAINS AND WITH BREXIT LOOMING, CAN THE PREEMINENT GLOBAL CITY STAY ON TOP?

RISING

The Shard reigns over London as its tallest building, dwarfing earlier icons such as Tower Bridge (center). More than 70 skyscrapers are under way, promising to redraw the cityscape even further.

Once a seedy warehouse district, King's Cross is a model of renewal—and livability. It's anchored by Granary Square, where a new college campus adds a youthful vibe and the steps along Regent's Canal invite lingering.

Tom Dixon
Shop

The centerpiece of a mile-long redevelopment along the Thames, the Battersea Power Station will be home to offices—Apple will be the main tenant—and residences. Critics say the project is too focused on luxury in a city short on affordable housing.

BY **LAURA PARKER**

PHOTOGRAPHS BY **LUCA LOCATELLI**

The Royal Botanic Gardens at Kew lie in a curve of the Thames, seven miles upriver from central London.

It's a pastoral respite from asphalt and exhaust, with thousands of plants collected from the British Empire's far-flung reach. To stroll past beds of Himalayan rhododendrons and Tasmanian grasses is to also understand the sweep of Britain's connectivity to the world beyond.

At Kew, though, one does not entirely escape the tumult of modern life. The gardens sit directly beneath the flight path into Heathrow. As I admired a massive, ancient oak, relocated from Iran during Queen Victoria's reign, a stream of jets descended out of the holding queue aloft. Spaced 27 to 40 seconds apart—Kew arborists know the timing—they formed a line homing in on the busiest two-runway airport on the planet. At certain times of the day, "it's just like bees

With time ticking on the "Six Public Clocks" installation, workers break for lunch on Reuters Plaza in the Canary Wharf financial district. Its status as the European banking center may be threatened by Brexit.

A COMPOSITE OF 20 IMAGES CREATED THE TIME-LAPSE EFFECT.

around a honeypot," says a commercial pilot who details Heathrow's traffic jams in Craig Taylor's oral history of modern London. "You'll be flying back in across from France … and it's all nice and relaxed … Then you hit the London frequency on the radio and suddenly everyone's jabbering away. There's a million and one voices on and the controller's not got five seconds to take a breath … It's busy, you're gonna hold. Everyone wants to get into London."

Bees to the honeypot: London is bigger and richer than ever. Three decades of growth transformed London from a fading grande dame into the preeminent global city and a leading center of culture, finance, and technology. The city is home to more than 8.8 million residents—a population expansion largely fed by immigration. And despite the upheaval of Brexit, London is on track to add two million more residents by 2050. All that growth fed a construction boom that is redrawing London's historic skyline and includes several of the largest regeneration projects in Europe. More than 500 new tall buildings are in the pipeline across Greater London. Half are going up in East London, soon to be better connected to West London when Crossrail, the $20 billion high-speed railway, opens its Elizabeth line next year, relieving congestion on the aging London Tube and cutting travel times between east and west by as much as half.

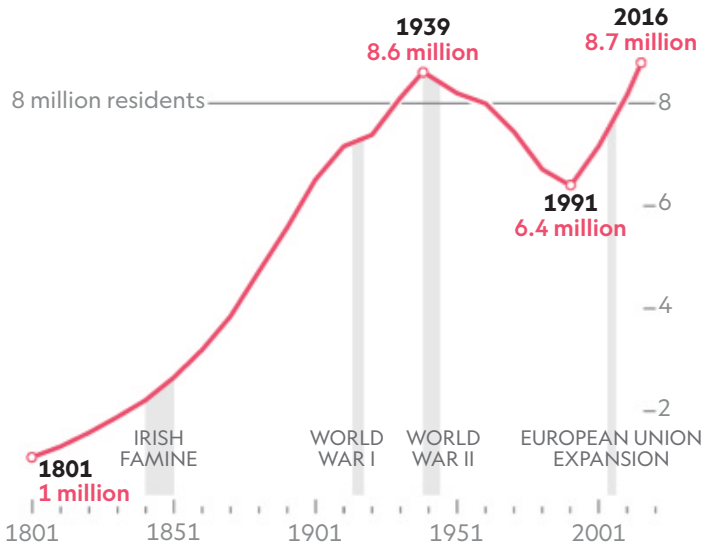
Meanwhile, defunct industrial sites along the Thames and the city's hundred-mile network

BALANCING LONDON'S GROWTH

Despite upheaval from Brexit, the bustling capital continues its upward trend, with rising numbers of residents and towering construction. As planners fashion new neighborhoods from defunct industrial sites, they balance the city's historic character with its future needs.

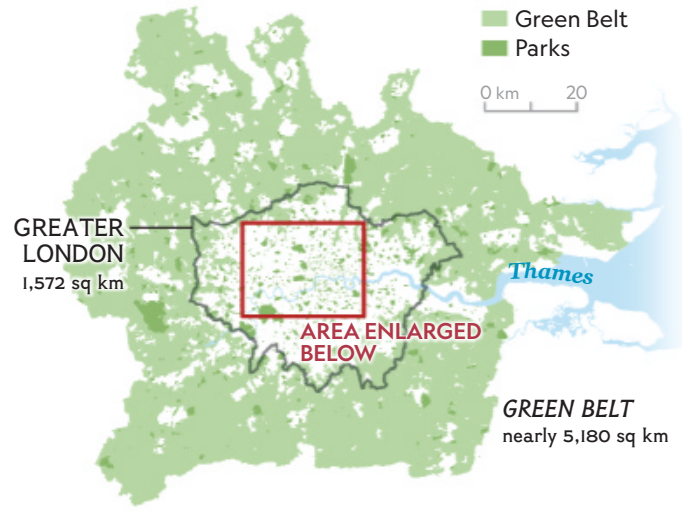
Population Rising

After World War II, thousands fled the capital for homes in the suburbs. In 2015 London's population finally surpassed its prewar peak; it adds an estimated 70,000 residents each year.



Limiting London

Designed to prevent sprawl, a ring of open space around the city was designated in 1935 and has grown since. Now the city debates whether portions should be developed for housing.



History vs. Growth

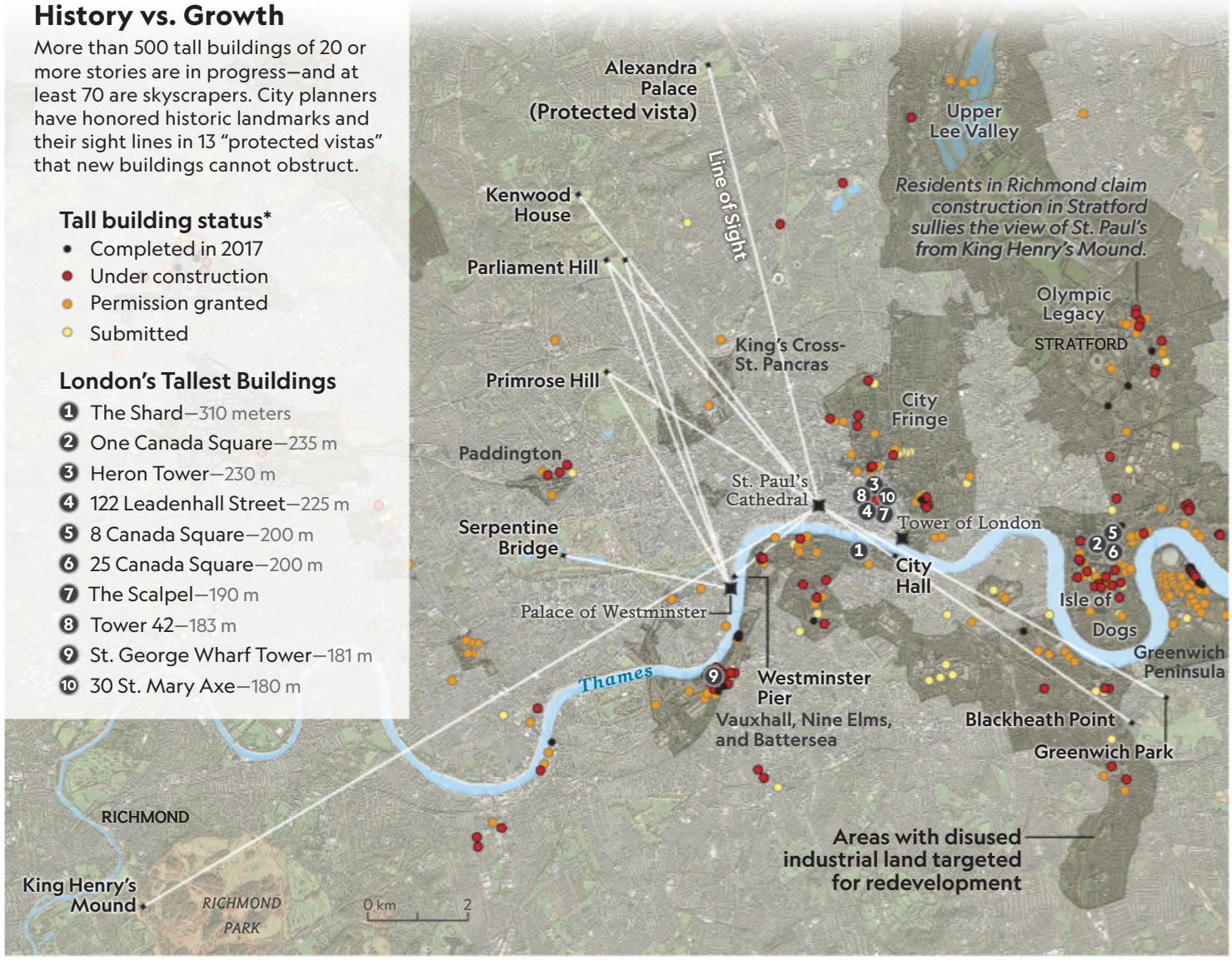
More than 500 tall buildings of 20 or more stories are in progress—and at least 70 are skyscrapers. City planners have honored historic landmarks and their sight lines in 13 "protected vistas" that new buildings cannot obstruct.

Tall building status*

- Completed in 2017
- Under construction
- Permission granted
- Submitted

London's Tallest Buildings

1. The Shard—310 meters
2. One Canada Square—235 m
3. Heron Tower—230 m
4. 122 Leadenhall Street—225 m
5. 8 Canada Square—200 m
6. 25 Canada Square—200 m
7. The Scalpel—190 m
8. Tower 42—183 m
9. St. George Wharf Tower—181 m
10. 30 St. Mary Axe—180 m



JAMES CHESHIRE AND OLIVER UBERTI

*DATA CURRENT TO 2017. SOURCES: U.K. MINISTRY OF HOUSING, COMMUNITIES, AND LOCAL GOVERNMENT; OFFICE FOR NATIONAL STATISTICS; LONDON VIEW MANAGEMENT FRAMEWORK; GREATER LONDON AUTHORITY; NEW LONDON ARCHITECTURE; EUROPEAN SPACE AGENCY

of canals are being reinvented as new neighborhoods—and pricey waterfront real estate—featuring pedestrian-friendly public spaces and retail shops that favor local entrepreneurs over chain outlets. King's Cross, a derelict railroad transfer point known more recently for prostitution and drugs, is showing Londoners what a well-rounded makeover looks like. The transformation includes the renewed King's Cross and St. Pancras rail stations (the latter home to the Eurostar train to Paris), a new campus for an art and design college, music venues, parks and fountains, and housing—both high-end and affordable. Google, Deep Mind (Google's artificial intelligence research lab), and Facebook are building unconventional London headquarters there. Google's 11-story "landscraper," large enough to house about 7,000 employees, may be the most original design. It stretches for a thousand feet, parallel to the King's Cross railway platforms, and boasts that its rooftop garden will grow "fields" of wildflowers and feature a running trail.

Across town, on the Thames's south side, a long-bedeviled development is under way that will reclaim the Nine Elms district, once better known for the defunct Battersea Power Station than enticing riverfront views. Reborn upscale, and helped in part by the new U.S. Embassy seat that opened here last year, the project also is positioning itself to be the city's food quarter, anchored by the New Covent Garden Market. The London headquarters of tech giant Apple will occupy six floors in the massive power plant's rebuilt boiler room.

Not surprisingly, London's run of prosperity arrived with the usual set of urban headaches, and as they have worsened, many wonder whether their great city is losing its allure. Traffic is terrible. Air pollution is so bad that two million Londoners are living with illegal levels of toxic air, according to London's emissions inventory agency. Rising land values have pushed housing prices beyond the reach of average Londoners, forcing even well-paid professionals to pack up the kids and move out in search of affordable suburbs where a family can live.

But three years of uncertainty over Brexit have trumped every urban annoyance. The U.K.'s unresolved withdrawal from the European Union has embroiled the government in political chaos that cost Prime Minister Theresa May her job, stymied industry planning, and threatens to bring the boom to an end. "Anyone who says anything about Brexit, however expert, is as likely to be wrong as right," says Simon Jenkins, former chairman of the National Trust and a veteran journalist and author. "Really, no one has a clue."

The U.K. economy has slowed, though London continues to add jobs. Large manufacturers, including Airbus and Japanese automakers, have threatened to leave if Brexit gets inked. On the other hand, Unilever and HSBC, after threatening to decamp for the Continent, are staying put. The pound is down, but London remains a leading source for venture capital and the global destination of choice for company headquarters, a distinction it has held since 2003, according to an analysis by the Centre for London, a progressive think tank.

"Airbus and the Japanese automakers are single stories. The one thing Brexit hasn't done so far is create this rats-leaving-the-sinking-ship type of departures," says Richard Brown, the center's research director. "But the mood here is exhaustion. People are saying that we should just get on and leave, and to hell with Europe. Or, alternatively, that we should call the whole thing off. It's been a disaster."

Will boom turn to bust? Can London take on its challenges and remain the world's great trading city and an appealing place to live? The idea that London teeters on the edge of unraveling seems unimaginable, even, and maybe especially, at a time like this. Londoners like to talk about their city's enduring resilience. They recite, predictably, London's ability to carry on through plague, the Great Fire of 1666, and the blitz bombing raids during World War II—all reassuring evidence that London will prevail again in its European divorce. In the current crisis, London is helped by the fact that there is no obvious challenger. Paris, Dublin, Amsterdam, and Frankfurt all have financial services industries, but none has quite the range of assets or the historic strengths that have carried London through 2,000 years, starting with the mother tongue. English is the universal language. London's trading connections, established when the empire ruled a quarter of the world, are embedded in its DNA and give London an edge, especially in Asia, over would-be European competitors.

"London is in a privileged position where it's kind of untouchable," says Peter Griffiths, a city

strategist at ING, the Dutch multinational financial services firm. "It's so far ahead of other cities, it can get away with things that other cities can't."

London's historic strength is surpassed only by its geography. It was the British, after all, who mapped global time zones after solving the mathematical mystery of longitude. London sits at the center of the world today because it placed itself there when it drew the prime meridian, where east meets west.

THE PREVIOUS PEAK for London's population coincided with the eve of World War II, when the city counted 8.6 million residents. London had been the world's most populous city for most of the industrial age, but the war left it in shambles. Londoners who hadn't fled ahead of the blitz—which killed 43,000 civilians and obliterated more than 70,000 buildings—fled the chaos of reconstruction afterward. They resettled in garden cities that grew into the suburbs of today and hunkered down as their country slogged through nearly four decades of postwar recovery.

As the manufacturing industry splintered, the docks of what was once the world's largest port fell victim to shipping modernization and closed. The death in 1965 of Winston Churchill, the great prime minister, marked the end of the fraying empire and, the *Observer* noted, "the last time that London would be the capital of the world." Population, meanwhile, continued a downward slide. But by the time it bottomed out at 6.4 million at the dawn of the 1990s, London's fortunes were again on the rise, spurred by the "Big Bang" on October 27, 1986: the day the financial services industry deregulated, enabling London to rival Tokyo and New York. A new financial district rose on the ruins of the West India Docks on the Isle of Dogs, a marshy nub that juts into the Thames. Canary Wharf, as the district is called, became London's first modern large-scale regeneration project.

Immigrants and foreign investment flowed in, and growth became the story of London for the next 30 years. Today Canary Wharf employs more than 100,000 people, and London has become a magnet for young, bright professionals from every corner of the world—who've changed the face of the city. Nearly 40 percent of London residents were born outside of the United Kingdom, and 300 languages are spoken on its streets.

In the shadow of 30 St. Mary Axe (aka the Gherkin), St. Andrew Undershaft is a rare medieval structure spared by the Great Fire and two world wars—events that created much of the open, public space in the square-mile area known as the City of London.

London is home to about 300,000 Indians, and well over 100,000 people each from Pakistan and Bangladesh. Hundreds of thousands moved to London as the European Union expanded, including about 177,000 Poles and 150,000 Romanians. Officially, 82,000 French live in the city, though other estimates go as high as 250,000. London officially surpassed its 1939 population peak when the city took note of the 8,615,246th arrival, in early 2015. The individual was never pinpointed, but it's more likely the newcomer showed up in a maternity ward than a border station; immigration had also started a baby boom.

So far Brexit hasn't slowed the pace of immigration, only changed the mix of who's

coming. Fewer migrate from EU member states, and more migrate from outside the EU, primarily South Asia, according to a Centre for London analysis.

FOR A BIRD'S-EYE VIEW of the city's changing skyline, I went to the top of the 52-story Cheesegrater—Londoners are fond of of nicknaming their skyscrapers—in the heart of the original financial district, also known as the City of London, with Peter Murray, an architect who heads New London Architecture, a design forum. We peer out at the pickle-shaped Gherkin (41 stories), the Walkie-Talkie (36 stories), and the Shard (95 stories), the dramatic sentinel that's the U.K.'s tallest high-rise.

The Cheesegrater, formally named the Leadenhall Building, won its nickname for its angular, wedge-shaped top floors, a design feature that complies with London's "protected view" regulations prohibiting obstructions of sight lines to historic landmarks. In this case the protected view allows pedestrians strolling along Fleet Street to see St. Paul's Cathedral and its 365-foot dome, which towered over London for more than 200 years. When cities began building skyscrapers in the 1880s, London never swooned. Londoners don't even call them that—the preferred term is "tall buildings," meaning buildings of at least 20 stories. The Gherkin changed Londoners' minds. It went up over community objections, replacing a historic building that had been

damaged by an IRA bombing in 1992 and that many wanted rebuilt. Today it is as beloved and recognizable as Big Ben, and helped smooth the way for a cluster of skyscrapers. By 2020 the collection will include the Flower Tower, the Vase, and the Can of Ham.

As we watch an impressive number of cranes swivel across the cityscape, Murray points east: Of the new buildings going up in London, 257 are in East London. Only a few of the total will truly scrape the sky. The future, he says, will push development to the outer boroughs, clustered around rail and Tube stations, creating multiple centers where people can live and work and shop—and abandon the long commute into central London.

'London is in a privileged position. It's so far ahead of other cities, it can get away with things that other cities can't.'

There isn't careful plotting for London's skyline, he says. Each borough, guided by voters, decides for itself what kind of development to approve. Bromley, farther from the city center and, Murray says, "the essence of suburban London," has no skyscrapers. Tower Hamlets, less than half the size though more central, has many.

What we can't see from our perch just beyond the horizon is the Green Belt, created in the 1930s to keep sprawl in check. At three times the size of the city it encircles, it eventually forced development to leapfrog over London, and now it feels to some like an ever tightening stranglehold around the city's girth. It includes parkland, golf courses, farms, but also brownfield sites and derelict buildings. Only an estimated 9 percent is publicly accessible. Suggestions that the Green Belt is the solution to London's housing problem are as plentiful as London rain. But most development is barred, and efforts to open it up to builders amount to political suicide.

Murray favors what he calls "sensible planning" around it. "But that doesn't mean, let it rip," he says.

SADIQ KHAN, the son of Pakistani immigrants and the fifth of eight children, became London's first Muslim mayor in 2016. The city's growth by then was twice the rate of the rest of the U.K. In his mayoral campaign, Khan promised "a better London" in his rapidly changing city. Brexit passed a month later. While London voters overwhelmingly opposed leaving the EU, the vote in the rest of the U.K. reflected a backlash against immigration and resentment that prosperity had not spread to the rest of the country. London may not contend with the megacity level of growth in Asia and Africa: According to one analysis, Lagos, Nigeria, now takes in 70 new residents an hour to London's nine. But that's still about 70,000 annually—the growth that Khan's London Plan anticipates through mid-century.

Khan attacked threats to London's livability on all fronts. Climate change? Becoming "zero carbon" by 2050 means more bicycles, fewer cars, a ban on the sale of diesel-burning autos, and building up a fleet of electric buses. Public safety? Protecting children on their walks to school and female pedestrians at night. Khan even unveiled a plan to save London's disappearing historic pubs, some of which had closed because of changing drinking habits and higher rents and taxes, and to fight childhood obesity by restricting fast food outlets. And Khan backed the designation of London, a city with 8.4 million trees and multiple large parks, as the world's first National Park City. The brainchild of geographer and National Geographic Explorer Daniel Raven-Ellison, the idea is to encourage Londoners to better acquaint themselves with the city's environment, which includes 15,000 species of wildlife and plants.

"One in seven children has not visited a green space in the past year," Raven-Ellison says. "I am talking about a cultural shift and challenging people's notions of what their relationship with nature should be like."

But Khan's most daunting task is housing. After he took office, he announced that London needs 66,000 new houses a year just to keep up with growth and pledged that half would be "genuinely affordable." Khan then came up with more than six billion dollars in government funding to build 116,000 affordable homes by 2022. As he campaigns for reelection in 2020, he promises to

Parks and green space make up a third of the city. Revelers barbecue at London Fields in Hackney, a part of East London increasingly popular with young residents. It shows in housing prices, which have risen sharply. Designed in the 1930s to limit growth, the Green Belt (below, in Redbridge) endures. Some say portions of the vast area, mostly private land not open to the public, could be tapped for development.

Visitors take in the view from the top of 20 Fenchurch Street, known as the Walkie-Talkie. Despite a controversial design—a "bullying presence," one critic called it—in 2017 it sold for $1.7 billion to a Hong Kong firm, a record price for a building in the city.

push Parliament for rent control. Many admire his housing ambitions but point to mayoral limitations: The mayor sets strategic targets for the city, but the 33 municipal councils determine development within their respective borders.

"Despite plan upon plan upon plan to build more housing, the truth is the rate of construction is nowhere near keeping up with the growth of the population," says Tony Travers, who directs government studies at the London School of Economics.

Jules Pipe, one of Khan's 10 deputy mayors, says it's essential to try. "If we exclude swaths of the public from being able to live and commute cheaply in the capital," he says, "then the whole capital begins to fail on everything, from being kept clean to whether we have a shortage of doctors at the hospital."

Central London is increasingly viewed as a place only for tourists and absentee Russian oligarchs and Saudi princes.

CENTRAL LONDON is often viewed as an island for tourists and absentee Russian oligarchs and Saudi princes who spend just a few weeks a year at their multimillion-dollar properties. Jenkins, the former National Trust chairman, sees London as becoming more of an investment market than a place where people actually live.

"They want to put their money into it and leave it, as if the city had become a bank," he says. "These towers of luxury apartments are simply blocks of gold."

Trevor Abrahmsohn, a real estate agent to the rich, says one of the side effects of being a global city is that it attracts wealth. The Qatari royal family owns more real estate in London than the British royal family, with a portfolio of quintessentially British icons that includes Harrods and Claridge's, most of the Shard, the former U.S. Embassy in Grosvenor Square (which will reopen as a luxury hotel), 20 percent of Heathrow Airport, and a portion of Canary Wharf.

"When the Shah of Iran was ousted, his first port of call was London," he says. "When the Nigerians made money in oil, they bought in London. When the Indians made money on the Nigerians, they bought in London. When the Berlin Wall fell, the Russians bought, and now it's the Chinese."

The Nine Elms project, which stretches over 500 acres along the Thames, is seen, fairly or unfairly, as a place filled with those stacks of bank accounts. It earned the name Dubai-on-Thames after the first round of apartments were sold mainly to foreign buyers, and advertises, among its many sumptuous amenities, the world's first "sky pool," which bridges the rooftops of twin buildings of luxury flats.

But the project also illuminates why Khan's housing targets may be so hard to reach. The power plant, one of the world's largest brick buildings, has long been an iconic landmark on the skyline. "An industrial St. Paul's," Jenkins says, and possibly large enough to fit St. Paul's inside. Pink Floyd featured the plant on an album cover, and several blockbuster films have used it as a backdrop.

The plant closed in 1983. But fame also saved it from—or prevented, if you prefer—demolition, locking in the huge cost of refurbishing it. Multiple developers came and went. In 2012 a Malaysian consortium took over the nearly $12 billion project, which includes remaking the plant into commercial and residential space and restoring its four chimneys. The developers also contributed nearly $400 million to the $1.3 billion construction of two new Tube stations, improving access to the area. The investment won them a reduction in the number of affordable housing units that had been slated.

Ravi Govindia, leader of the Wandsworth borough council, which approved the project, says the infrastructure and restoration more than compensated. "Every development has a finite contribution it can give to the improvement of public services," he says. "Affordable housing is one component."

The development also will contain two riverside piers, two primary schools, two health centers, improved bicycle paths, and Linear Park, which is styled after New York's High Line and runs like a "green spine" through the entire district.

"The greatest challenge in any urban setting is how do you renew an area and provide the things

Two South London ventures embody urban ingenuity and sustainability: Growing Underground took over a sprawling WWII-era bomb shelter for a hydroponic farm powered by LED lighting (top). It serves Marks & Spencer, area restaurants, and markets. Built in 2002, BedZED was a pioneer of the eco-village concept. Innovative design and solar power reduce energy needs in its 100 homes.

that make urban living bearable and desirable?" he asks. "You can't do that by doing a lot of one thing. You need to do lots of bits of things."

OPPORTUNITY IS ALSO FOUND at the site of the 2012 Olympics. It's been converted to a much-used Queen Elizabeth Olympic Park, with the swimming pool complex, the velodrome, and the stadium. The athlete's village, where 17,000 competitors slept, was refashioned into nearly 3,000 apartments. Half of the units rent for market rate, half qualify as affordable, many with enough bedrooms to hold a family.

Last year Khan outlined a $1.4 billion expansion that includes more housing, a dance theater, new campuses for both the London College of Fashion and University College London, and a branch of the Victoria and Albert Museum.

In the run-up to the games, then Mayor Ken Livingstone emphasized the event's potential to jump-start a regeneration of neglected, impoverished parts of East London. Ricky Burdett, head of the London School of Economics' cities program and a top adviser for the games, says the pieces are in place for a multidecade renewal project, like King's Cross.

"When we first looked the site over," he recalls, "we said we must be nuts. There were tires burning in the center, where the Olympic stadium was built." One of the first chores was to connect the site to the surrounding area by building some 30 bridges, viaducts, walking paths, and bicycle lanes. "None of this would have been built if it were not for the games," he says. "But this is a 35-year project."

Our tour ends near Tower Hamlets, a borough that may most represent London's changes and contradictions. It's tiny, encompassing only eight square miles, much of it former industrial dockland. But it is London's fastest growing borough, with an estimated 308,000 people, containing some of the city's poorest enclaves, and some of the richest.

The borough has been a beachhead for newly arrived immigrants for three centuries. A landmark building encapsulates those layers of history: It was a meetinghouse for French Huguenots during the 18th century, then a synagogue for Jews fleeing Eastern Europe, and today it's a mosque. The nearby streets have been dubbed Banga Town, in celebration of the Bangladeshis, now Tower Hamlets' largest immigrant group.

The borough also takes in Canary Wharf, the third largest contributor to the U.K. economy. Among the tall buildings going up across London, 84 are being built in Tower Hamlets, more than any other borough. Many are part of an expansion to transform Canary Wharf into a livable community instead of just a workplace. It's where uncertainty about Brexit's effect on the thriving financial services industry is most keenly felt. Some construction has paused. Some banking jobs have shifted to Paris or Frankfurt. Last summer, worried borough leaders set up a Brexit commission to deal with the consequences should jobs disappear and immigration limits be set.

If the U.K. leaves the European Union, it will be the first time in centuries that London

With the city's 100-mile network of canals—Regent's Canal in King's Cross is seen here—houseboats became a response to high rents on land. But boaters now face escalating mooring fees along with new restrictions that limit access.

will be standing alone in the world. "England went from being an imperial power with a long history as a trading empire, and then afterwards as a principal city within the EU," Brown says. "The transition to this new status, whether as an unleashed global city or something less powerful, is quite dramatic."

And yet, despite Brexit anxieties, optimism about this ancient trading city persists. One of Canary Wharf's newest additions, the station for the new Elizabeth line, is a rail station for the ages: seven stories high and loaded with retail, shops, cafés, a movie theater, and a gym. If you pass through, take time to go all the way up to the roof. There, a garden that celebrates London's place in history and geography stretches for nearly a thousand feet, with east and west "hemispheres" neatly planted with flora native to countries visited by the ships of the West India Docks. I paused in the center, at the dividing line where the hemispheres meet. We're just a short boat ride from Greenwich, where the real prime meridian line–longitude zero–is painted on the pavement outside the Royal Observatory. A replica is drawn here, between the bamboo in the east and the ferns in the west, and serves as a reminder: No matter what else befalls it, London remains at the center of the world. □

Laura Parker wrote about plastic pollution in the May issue. **Luca Locatelli** photographed stories on Dubai and innovations in Dutch agriculture for the September and October 2017 issues.

YOUR SHOT

OLIVIER APICELLA

PHOTOS FROM OUR COMMUNITY

WHO

Apicella, a French photographer living in Ho Chi Minh City, Vietnam

WHERE

A flower farm in Sa Dec, in Vietnam's Mekong Delta

WHAT

DJI Mavic 2 Pro drone with a 28mm lens

The town of Sa Dec, Vietnam, is known for its sprawling flower farms, which are particularly vibrant before the Lunar New Year celebrations each winter. Apicella visited the town to photograph the colorful plants and the way they're traditionally grown: on raised racks to control exposure to water, and tended by boat. One evening, just before sunset, a daisy farmer invited Apicella to take pictures of his fields. While the farmer watered his plants, Apicella launched his drone above the man and lined up the rows at perfect angles. Later, as he sipped tea with the farmer and his family, he took a closer look at the scene he had captured, with the striking swirl of water. The man's three children were especially excited to see what Apicella had photographed. It was their first encounter with a drone.

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